

TC
824
C2
A2
no. 82

LIBRARY
UNIVERSITY OF CALIFORNIA
DAVIS

C824
2
2
82

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
DIVISION OF RESOURCES PLANNING

BULLETIN NO. 82

UNIVERSITY OF CALIFORNIA
LIBRARY

DAVIS
COPY 2

UPPER TULE RIVER
RECONNAISSANCE INVESTIGATION



EDMUND G. BROWN
Governor



HARVEY O. BANKS
Director of Water Resources
UNIVERSITY OF CALIFORNIA
DAVIS
MAY 23 1961
LIBRARY

NOVEMBER 1960

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
DIVISION OF RESOURCES PLANNING

BULLETIN NO. 82

UPPER TULE RIVER RECONNAISSANCE INVESTIGATION

EDMUND G. BROWN
Governor



HARVEY O. BANKS
Director of Water Resources

NOVEMBER 1960

LIBRARY
UNIVERSITY OF CALIFORNIA
DAVIS

TABLE OF CONTENTS

	<u>Page</u>
LETTER OF TRANSMITTAL	v
ORGANIZATION, DEPARTMENT OF WATER RESOURCES	vi
ORGANIZATION, CALIFORNIA WATER COMMISSION	vii
ORGANIZATION, TULARE COUNTY BOARD OF SUPERVISORS	viii
ACKNOWLEDGMENT	ix
 CHAPTER I. INTRODUCTION	 1
Related Investigations and Reports	2
Area Under Investigation	3
 CHAPTER II. WATER SUPPLY	 7
Precipitation	7
Runoff	8
Water Quality	10
 CHAPTER III. WATER UTILIZATION AND REQUIREMENTS	 13
Land Use	13
Present Land Use	13
Potential Land Use	15
Present Water Supply Development	17
Tule River Water Rights	17
Applications	17
Surface Diversions Within the Upper Tule River Basin	19
Irrigation Use	19
Urban Use	20
Recreational Use	20
Hydroelectric Power Use	20

TABLE OF CONTENTS

	<u>Page</u>
Downstream Users	21
Success Reservoir	25
Water Requirements	26
Irrigation Water Requirements	26
Urban Water Requirements	28
Recreational Water Requirements	29
Supplemental Water Requirements	29
Monthly Demands for Water	30
CHAPTER IV. AVAILABILITY OF WATER	31
Existence of Water Available for Development in the Upper Tule River Basin	31
Exchange Possibilities	33
Existing Ditch Companies	34
Friant-Kern Canal	34
Success Reservoir	36
San Joaquin Valley-Southern California Aqueduct	37
East Side Division of the Central Valley Project	37
CHAPTER V. PLANS FOR DEVELOPMENT OF BASIN STORAGE	39
North Fork Project	41
Middle Fork Project	44
South Fork Project	47
Pumping From Success Reservoir	50
Land Management	50
Distribution System	52

TABLE OF CONTENTS

	<u>Page</u>
Repayment Capacities	52
Service Areas	53
Summary of Plans for Development	54
CHAPTER VI. CONCLUSIONS AND RECOMMENDATIONS	57
Conclusions	57
Recommendations	60

TABLES

Table Number

1	Precipitation Stations In or Near the Upper Tule River Basin	7
2	Stream Gaging Stations in the Tule River Basin	9
3	Average Monthly Distribution of Runoff at the Gaging Station on the Tule River Near Porterville . . .	9
4	Classification of Irrigation Waters	10
5	Mineral Quality of the Tule River Near Porterville	11
6	Land Use in the Upper Tule River Basin, 1957	14
7	Water Utilization in the Upper Tule River Basin in 1957	21
8	Tule River Diversions (Mouth of South Fork to Oettle Bridge)	22
9	Water Imported Into the Tule River Basin Via the Friant-Kern Canal, 1956-58	24
10	Present and Probable Ultimate Seasonal Irrigation Water Requirements in the Upper Tule River Basin	28
11	Supplemental Seasonal Water Requirements for the Upper Tule River Basin	29

TABLE OF CONTENTS

<u>Table Number</u>		<u>Page</u>
12	Monthly Distribution of Annual Water Demands	30
13	Runoff of the Tule River at Worth Bridge and Turnbull Gaging Stations	32
14	Areas and Capacities of North Fork Reservoir	42
15	Areas and Capacities of Mahogany Flat Reservoir	45
16	Areas and Capacities of Indian Gate Reservoir	47
17	Comparison of Potential Water Development Projects for the Upper Tule River Basin	56

PLATES

(Plates are bound at end of bulletin)

<u>Plate Number</u>	
1	Lines of Equal Mean Seasonal Precipitation
2	Tule River Service Areas Below Success Dam
3	Possible Development

APPENDICES

A	Cooperative Agreement Between the State of California, Department of Water Resources, and Tulare County	A-1
B	Applications to Appropriate Water From the Tule River	B-1
C	Surface Water Diversions in the Upper Tule River Basin	C-1
D	Comments of Tulare County, prepared by Tulare County Water Commission	D-1



STATE OF CALIFORNIA
Department of Water Resources
SACRAMENTO

November 1, 1960

Honorable Edmund G. Brown, Governor,
and Members of the Legislature
of the State of California

Gentlemen:

I have the honor to transmit herewith Bulletin No. 82 of the Department of Water Resources, entitled "Upper Tule River Reconnaissance Investigation", as authorized by Articles 4 and 5 of Chapter 1, Part 6, Division 6, of the Water Code of the State of California.

Bulletin No. 82 includes estimates of present and probable ultimate water requirements of the Upper Tule River Basin. It contains an inventory of the water resources of the basin and considers availability of water for further development. Preliminary plans and cost estimates are presented for storage and distribution of supplemental water in the Upper Tule River Basin, and consideration is given to availability and cost of water for exchange between the valley floor and the upper basin.

Very truly yours,

A handwritten signature in dark ink, reading "Harvey O. Banks". The signature is fluid and cursive, with the first letters of the first and last names being capitalized and prominent.

HARVEY O. BANKS
Director

ORGANIZATION

DEPARTMENT OF WATER RESOURCES

Harvey O. Banks Director of Water Resources
Ralph M. Brody Deputy Director of Water Resources
James F. Wright Deputy Director of Water Resources
William L. Berry Chief Engineer, Division of Resources Planning
John M. Haley Assistant Division Engineer

This report was prepared
under the direction of

William L. Horn
Principal Hydraulic Engineer

and

Carl L. Stetson
Supervising Hydraulic Engineer

by

Eugene F. Serr Senior Hydraulic Engineer
Eugene H. Gunderson Associate Civil Engineer

Assisted by

Leland R. Illingworth Supervising Hydraulic Engineer
Charles F. Kleine Senior Hydraulic Engineer
H. Duane Woods Senior Engineering Geologist
Stanley A. Feingold Assistant Hydraulic Engineer
C. Dale Spaulding Assistant Civil Engineer
Kenneth R. Quinn Civil Engineering Technician
Carl J. Busse Civil Engineering Technician
John L. James Supervisor, Drafting Services

Porter A. Towner Chief Counsel
Paul L. Barnes Chief, Division of Administration
Isabel C. Nessler Coordinator of Reports

ORGANIZATION
CALIFORNIA WATER COMMISSION

JAMES K. CARR, Chairman, Sacramento

WILLIAM H. JENNINGS, Vice Chairman, La Mesa

JOHN W. BRYANT, Riverside

GEORGE C. FLEHARTY, Redding

JOHN P. BUNKER, Gustine

JOHN J. KING, Petaluma

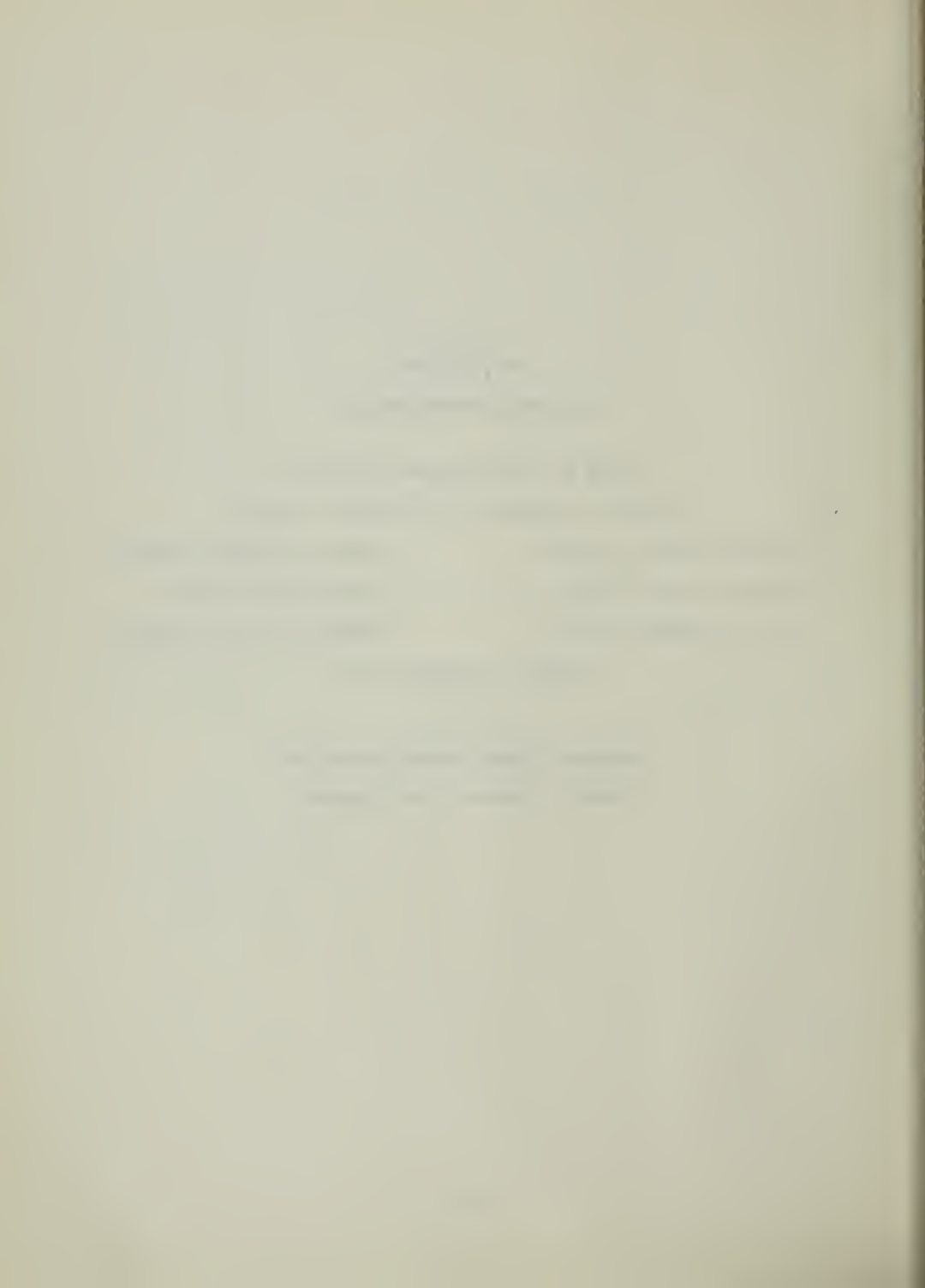
IRA J. CHRISMAN, Visalia

KENNETH Q. VOLK, Los Angeles

MARION R. WALKER, Ventura

WILLIAM M. CARAH, Executive Secretary

GEORGE B. GLEASON, Chief Engineer



ORGANIZATION

TULARE COUNTY BOARD OF SUPERVISORS

HARRY W. PERRY, Chairman

CHARLES J. CUMMINGS

J. MALCOLM CRAWFORD

HALVER J. HADDOCK

JOHN R. LONGLEY



ACKNOWLEDGMENT

Valuable assistance and data used in this investigation were contributed by agencies of the State and Federal Governments, Tulare County, public districts, and by private companies and individuals. This cooperation is gratefully acknowledged.

Special mention is also made of the helpful cooperation of the Tule River Soil Conservation District and the Sacramento District, United States Army Corps of Engineers.

CHAPTER I. INTRODUCTION

The unregulated flow of the Tule River and its tributaries has proven insufficient to meet the increasing demands for water in the upper Tule River Basin. The development of additional water supplies for all beneficial uses is necessary if the upper basin is to achieve its agricultural and recreational potential.

Representatives of the Tule River Soil Conservation District appeared in February 1957 before the former State Water Resources Board (now the California Water Commission) and requested that a comprehensive survey be conducted of the water resources of the upper Tule River area. Subsequent negotiations with the County of Tulare culminated in cooperative agreement No. 160005, dated June 30, 1958, for an investigation and report by the Department of Water Resources.

The broad objective of the investigation was to evaluate on a reconnaissance scale the possibilities for a plan of development for the upper Tule River area.

The work program to accomplish this broad objective included the review of previously published pertinent reports; the determination of present and probable ultimate water requirements in the upper basin; the collection, compilation, and analysis of pertinent water resource and water rights data; the determination of the amount of water available for development; a study of possible plans for development; and a determination of the practicability of obtaining additional water for the upstream area by effecting an exchange with present users of Tule River water on the San Joaquin Valley floor.

The agreement entered into by the State of California and the County of Tulare on June 30, 1958, and the detailed work program are included as Appendix A.

Related Investigations and Reports

The following reports of prior investigations containing pertinent information were reviewed in connection with the current investigation.

Althouse, Irvin N., Consulting Engineer, "Water Requirements of Tulare County". January 1942.

California State Department of Public Works, Division of Engineering and Irrigation, "Water Resources of Tulare County and Their Utilization". Bulletin No. 3. 1922.

California State Department of Public Works, Division of Water Resources, "Report on Irrigation Districts in California, 1944-50". Bulletin No. 21-P. 1951.

----. "Office Report on Tule River Soil Conservation District". December 1955.

California State Department of Water Resources, "The California Water Plan". Bulletin No. 3. May 1957.

----. "Ground Water Conditions in Central and Northern California, 1957-58". October 1959.

California State Water Project Authority, "Tule River-Deer Creek Area in Tulare County". Office Report No. 2 (b). August 1940.

California State Water Resources Board, "Water Resources of California". Bulletin No. 1. 1951.

California State Water Resources Board, "Water Utilization and Requirements of California". Bulletin No. 2. June 1955.

Sorenson, James F., Consulting Engineer, "Report on Water Resources and Water Needs of Tulare County". August 1959.

United States Corps of Engineers, Sacramento District, "Success Project, Part 1, Hydrology". December 1949.

----. "Success Project, Report on Preliminary Cost Allocation Studies". June 1956.

----. "Preliminary Definite Project Report, Success Dam and Reservoir, Tule River, California". June 1959.

United States Department of Agriculture, Forest Service, "Report to the Federal Power Commission on the Water Powers of California". 1928.

In addition to these reports, data were utilized from the Inventory of Water Resources and Requirements of California currently being conducted

by the Department of Water Resources as authorized by Section 232 of the Water Code. For the purposes of this inventory, the State has been divided into a large number of hydrographic units. The inventory of the Tule River hydrographic unit, covering the Tule River watershed above Success Dam, has been completed, and the data, pertaining essentially to stream diversions, land use, and land classification, were available and utilized in the current investigation. The complete data are in the process of being published in a report of that investigation.

Area Under Investigation

The area under investigation comprises the 392 square-mile drainage basin of the Tule River above Success Dam. This area is hereinafter referred to as the upper Tule River Basin. Location of the area is shown on Plate 1. Water utilization and development in the Tule River drainage basin below Success Dam were studied in order to ascertain the availability of Tule River water for use in the upper basin.

The upper Tule River Basin is a mountainous fan-shaped area situated on the western slope of the southern Sierra Nevada. Elevations in the upper basin range from about 550 feet at Success Dam to about 10,000 feet in the headwater area. The basin is drained by three main forks of the Tule River which flow in a westerly or southwesterly direction and join near the foothill line. The North and Middle Forks of the Tule River join at Springville; the South Fork joins the main river about one mile above Success Dam.

The main forks of the Tule River have an average slope of about 350 feet per mile. They are fed by numerous short, steep streams with slopes ranging from about 400 feet per mile to almost 1,000 feet per mile. About four miles west of Success Dam, the river reaches the San Joaquin Valley floor and divides into numerous distributary channels. These channels pass through a

rich agricultural area and eventually reach Tulare Lake, located approximately 46 miles west of Success Dam.

The climate in the upper Tule River Basin varies considerably, principally because of large differences in elevation. In the vicinity of Success Reservoir the climate is typical of that in the San Joaquin Valley, being characterized by fairly mild winters and hot dry summers. Recorded temperatures at Porterville show a minimum of 18° F. and a maximum of 114° F. for the 56-year period from 1896 to 1952. At Porterville, the average frost-free period is approximately 250 days, extending from the first part of March to the latter part of November. Short periods of freezing temperatures are experienced at infrequent intervals. In the upper regions of the basin, winter precipitation usually falls as snow.

The upper Tule River watershed consists of rugged mountains. The granitic rocks of the mountains extend westward to within a few miles of Porterville. The Tule River has built an alluvial fan extending westward in the San Joaquin Valley from an apex in the vicinity of Porterville. The remnants of older alluvial fans occur both north and south of this present Tule River fan. The most recent alluvial deposits occur along the active channel of the river and reach considerable depths near the mouth of the stream canyon. Pleasant Valley, the largest area of flat land in the upper basin, is located just above Success Reservoir. The surface of this valley is partially alluviated.

The bedrock of the region consists largely of granitic rocks, although some metamorphic rocks are present. The area is considered only moderately active seismically. The only recently recorded earthquake epicenter in the area was a small shock near Springville in 1948.

The soils of the upper Tule River Basin have been derived from rocks of the western slope of the Sierra Nevada. These soils may be segregated into three broad groups: residual soils, Recent alluvial soils, and older flood plain soils.

The residual soils of the rolling and the mountainous portions of the area were formed in place from the weathering of parent rock. Most of these soils are coarse-textured and well-drained. Soil depth varies from very shallow in the western portion of the basin to relatively deep on the flatter portions of the timbered, mountainous areas. Recent alluvial soils occur in relatively small and irregular bodies of deep, well-drained, coarse-textured alluvial fans along the existing stream channels. Agricultural development in these areas has been limited due to the hazards of erosion and flooding by the adjacent streams. Older alluvial flood plain soils occur at lower elevations on the smooth to gently undulating land southwest of Springville. These soils, characteristically fine-textured, are underlain by moderately dense clay deposits.

The present population of the upper basin, excluding the area to be inundated by Success Reservoir, is approximately 2,250. This figure includes about 250 patients of Tulare and Kings County Hospital and about 160 residents of Tule River Indian Reservation. About 1,000 people reside in Springville, exclusive of the hospital patients. Fifty percent or more of the people working in Springville are reportedly nonresidents.

Two local public agencies in the upper basin are concerned with development and use of water and land. The Springville Public Utility District operates a municipal water supply system for residents of the Springville area. The Tule River Soil Conservation District was formed in 1955 to promote control of erosion, to foster good irrigation practices, and to generally aid agriculture by utilizing the services of the United States Soil Conservation

Service. The district comprises over 237,000 acres, essentially the entire upper basin. The district performs no direct water development functions, but has assisted farmers in obtaining planning and financial assistance from the Soil Conservation Service in the construction of many small water conservation reservoirs.

In addition to the above local agencies, the United States Army Corps of Engineers is presently constructing Success Dam for flood control and conservation purposes. The United States Bureau of Reclamation will negotiate a contract with present users for repayment of conservation benefits.

CHAPTER II. WATER SUPPLY

Present water supplies in the upper Tule River Basin are derived from direct precipitation, natural runoff, and to a minor extent, by pumping from ground water storage. This chapter describes the water supply phase of the investigation under the principal headings "Precipitation", "Runoff", and "Water Quality". Opportunity for ground water development is limited in the upper basin and is not given further consideration in this report.

Precipitation

Precipitation data collected at Porterville have been published continuously since 1893 by the United States Weather Bureau. Shorter records of precipitation are available for six stations in the upper basin above Success Dam. The names of the stations, the periods of record, and the seasonal precipitation, adjusted to a 51-year base period, 1904-55, are shown in Table 1. The locations of these stations are shown on Plate 1, "Lines of Equal Mean Seasonal Precipitation".

TABLE 1
PRECIPITATION STATIONS IN OR NEAR THE UPPER TULE RIVER BASIN

Plate 1 reference number	Precipitation station	Period of record	Mean seasonal precipitation, in inches of depth
1	Springville-Tule Headworks	1907 to date	37.0
2	Camp Wishon	1940 to date	33.0
3	Camp Nelson	1959 to date	-
4	Tule River Intake	1910-23	30.5
5	Springville 7 ENE	1953-55	25.2
6	Springville Ranger Station	1940 to date	17.6
7	Porterville	1893 to date	10.7

About 80 percent of the seasonal precipitation occurs during the five-month period from December through April. During late fall and spring, precipitation usually occurs as scattered intermittent showers or as thunderstorms. These storms are usually characterized by a high rate of precipitation and are confined to areas of about 50 square miles or less. Precipitation during summer and early fall months is negligible.

During the winter, precipitation usually falls as snow above the 5,000-foot elevation. However, some extremely warm winter storms have produced rain as high as 9,000 feet. The areas above 5,000 feet are usually covered to a considerable depth with snow by the end of February.

Mean seasonal depth of precipitation on the entire drainage basin above Success Dam averages about 31 inches, ranging from about 15 inches at the dam to about 50 inches in the mountains near the northern border of the watershed. Lines of equal mean seasonal precipitation in the basin are shown on Plate 1.

Runoff

Runoff records have been collected for a number of years at several stations in and downstream from the upper Tule River Basin. The location, drainage, area, period of record, and average runoff for pertinent gaging stations are shown in Table 2. The locations of these stations are shown on Plate 1.

The gaging station, Tule River near Porterville, located just above the confluence of the south fork and the main stem has the longest continuous record in the basin. The average seasonal runoff measured at this station for the 56-year period from 1901-02 through 1956-57 was about 102,000 acre-feet. Maximum and minimum seasonal runoff recorded at this station was 335,000 acre-feet (1905-06) and 14,000 acre-feet (1930-31), respectively. The average monthly distribution of runoff is shown in Table 3.

TABLE 2

STREAM GAGING STATIONS IN THE TULE RIVER BASIN

Plate 1 reference number	Gaging station	Drainage area, in square miles	Period of record	Average seasonal runoff for period of record, in acre-feet
1	North Fork of Middle Fork Tule River near Springville	39.5	1909-12 1939-56	26,400
2	South Fork of Middle Fork Tule River near Springville	44.1	1909-12	27,900
3	Bear Creek near Springville	13.1	1911-16	5,200
4	North Fork Tule River near Springville	98	1957	-
5	Tule River near Springville	229	1957	-
6	Tule River near Porterville	261	1901-57	102,200
7	Tule River at Worth Bridge, near Porterville	395	1944-57	111,600
8	South Fork Tule River near Success	105	1930-54 1956-57	30,000
9	South Fork Tule River near Porterville	79.7	1910-25 1927-32	22,900

TABLE 3

AVERAGE MONTHLY DISTRIBUTION OF RUNOFF AT THE
GAGING STATION ON THE TULE RIVER NEAR PORTERVILLE

Month	Acre-feet	Percent	Month	Acre-feet	Percent
October	500	0.5	April	23,100	22.6
November	2,800	2.7	May	21,400	20.9
December	5,500	5.4	June	9,300	9.1
January	6,500	6.4	July	1,300	1.3
February	15,500	15.2	August	100	0.1
March	16,100	15.7	September	<u>100</u>	<u>0.1</u>
			TOTALS	102,200	100.0

A gaging station on the South Fork of the Tule River near Success has been maintained from 1930 to 1954 and from 1956 to date. The average seasonal runoff, adjusted to the 56-year period 1901-02 through 1956-57, was about 30,000 acre-feet, ranging from a maximum of about 95,000 acre-feet to a minimum of about 4,000 acre-feet.

The unimpaired runoff of the entire Tule River above Porterville for the period 1895 to 1947 was estimated as 140,000 acre-feet per season.

A portion of the winter precipitation which falls in the upper Tule River Basin is retained in the snowpack which accumulates in the high mountain area. During March, April, and May, increasing temperatures cause the snowpack to melt, with resulting heavy runoff during these months. About 88 percent of the seasonal runoff occurs during the period from January through June.

Water Quality

Because of diverse climatological conditions and variations in crops and soils in California, only general limits of quality for irrigation waters can be considered for purposes of water quality determination. Irrigation waters can be divided into three broad classes, as listed in Table 4.

TABLE 4
CLASSIFICATION OF IRRIGATION WATERS

Chemical properties	Class I Excellent to good	Class II Good to injurious	Class III Injurious to unsatisfactory
Total dissolved solids:			
Parts per million	Less than 700	700-2,000	More than 2,000
Conductance, in micromhos per centimeter at 25° C.	Less than 1,000	1,000-3,000	More than 3,000
Chloride, in parts per million	Less than 175	175-350	More than 350
Sodium, in per cent of base constituents	Less than 60	60-75	More than 75
Boron, in parts per million	Less than 0.5	0.5-2.0	More than 2.0

A water sampling station is operated on the Tule River near Porterville by the Department of Water Resources. Average values and ranges of pertinent chemical properties of 24 monthly samples taken at this station during 1955 and 1956 are shown in Table 5.

TABLE 5
MINERAL QUALITY OF THE TULE RIVER
NEAR PORTERVILLE

Chemical property	Average of 24 samples collected during 1955 and 1956	Range
Total dissolved solids, in parts per million	154	87-265
Chloride ion concentration, in parts per million	8.6	2.4-20.0
Sodium, in percent of base constituents	22	19-25
Boron, in parts per million	0.12	0.03-0.22

A comparison of these averages with the limits shown in Table 4 indicates that the Tule River contains excellent Class I water, suitable for most plants under any condition of soil and climate.

CHAPTER III. WATER UTILIZATION AND REQUIREMENTS

This chapter contains information on land use, on the nature and magnitude of water utilization, and on present water requirements in the upper Tule River Basin. In addition, estimates of ultimate water requirements for the upper Tule River Basin are included. The data for the studies were derived largely from the Department of Water Resources investigation, "Inventory of Water Resources and Requirements".

Land Use

Lands in the upper basin were first developed for agricultural purposes in the 1850's. Springville, the only town in the upper basin, was settled in the 1890's. Lands within the upper basin have since been developed for agricultura, urban, and recreational purposes.

Present Land Use

A detailed study of land use in the upper basin was conducted by the Department of Water Resources in 1957. Table 6 presents the results of this study.

TABLE 6

LAND USE IN THE UPPER TULE RIVER BASIN, 1957

Land use	Area, in acres
Irrigated lands	
Mixed pasture	1,430
Native pasture	1,262
Meadow pasture	129
Field crops	174
Citrus crops	780
Deciduous	115
Idle in 1957	<u>736</u>
Subtotal	4,626*
Dry-farmed	1,013
Naturally irrigated meadow lands	206
Recreational	
Residential	275
Parks	3,524
Urban	242
Native vegetation	<u>240,804</u>
TOTAL	250,690

* Success Reservoir will inundate 448 acres of irrigated land.

Irrigated lands include all agricultural lands which use applied water in addition to that supplied by direct precipitation.

Dry-farmed lands are cultivated areas which receive their entire water supply from natural precipitation. This includes lands which were tilled but not planted at time of the 1957 survey, as well as idle lands formerly dry-farmed.

Naturally irrigated meadow lands utilize water from a naturally high water table. Mountain meadows adjacent to streams fall into this category.

Recreational lands include camp and trailer sites, resorts, and permanent and summer home developments in predominantly recreational areas. Also included are motels and other commercial developments which are necessary to service recreational areas.

Urban lands include the total areas of cities, towns, small communities, and industrial areas. These areas were not necessarily fully developed at the time of the survey. The limiting density used to determine community boundaries was approximately one residence for every two acres.

Land use indicated as native vegetation includes all lands in the upper basin which do not fall into one of the above categories. This use includes range land, commercial timberland, and forest land.

Potential Land Use

For purposes of this report, lands in the upper Tule River Basin have been separated into three general classes: Irrigable, urban, and recreational. Irrigable lands were further segregated into valley lands, gently sloping hill lands, and steeply sloping and rolling hill lands. Valley lands have an average gradient of less than four percent and are suited for all climatically adapted crops. Gently sloping and steeply sloping hill lands have maximum

slopes of 20 per cent and 30 percent, respectively, and aside from topographic limitations, are suitable for all climatically adapted crops.

The survey indicates that there are approximately 17,500 acres of irrigable lands in the upper basin. Of the 17,500 acres, 3,000 are classed as valley lands, 11,800 are classed as gently sloping hill lands, and 2,700 are classed as steeply sloping hill lands. These gross acreages are reduced by considerations, such as the size, shape, and location of various parcels, which preclude their development, and the fact that some portion of the land will lie fallow or idle each year. In addition, lands devoted to rights of way and farmsteads are included in the gross figures. Due to these considerations, the approximate area of net irrigable land in each class was estimated as follows: valley lands, 2,700 acres; gently sloping hill lands, 10,000 acres; and steeply sloping hill lands, 2,200 acres. The total net irrigable area is approximately 14,900 acres.

Continued urban development in the upper basin is anticipated in the vicinity of Springville. Based on an anticipated population of nearly 2,500 and the present density of about five persons per acre, it is estimated that about 550 acres may ultimately be used for urban development.

The mountains and streams in the upper Tule River Basin provide good recreational potential for hunting, fishing, and similar outdoor activities. Rapidly increasing demands for outdoor recreational facilities make it evident that considerable areas would be devoted to these purposes in the future. The department has estimated that about 9,400 acres would be devoted to recreational use in the upper basin under conditions of ultimate development.

Present Water Supply Development

The nature and extent of present water supply development in the Tule River Basin are defined by present rights to, and surface diversions of, Tule River water. Although comprehensive adjudication has not been made of the rights to the use of water from the Tule River, tentative diversion schedules have been adopted based on appropriation and actual use, court decrees and stipulations, agreements, and compromises.

Tule River Water Rights

Litigation concerning water rights in Tule River has been concentrated largely in four major lawsuits. In addition, there have been many minor lawsuits to quiet disputes between individual parties. Since the four major decrees above resulted from suits between different parties, the water rights were established only as against the plaintiffs and defendants of those suits. For example, the Pleasant Valley Canal Company was a defendant in three of the suits and was decreed a different quantity of water as its right by each. None of these three water right quantities can be considered as the final right of the Pleasant Valley Canal Company, but only as a right against the various plaintiffs. It is not possible, therefore, to establish a single diversion schedule on the basis of the court decrees. The decrees do, however, establish the fact that an order of priority in amount and time exists on the stream which future upstream developments must recognize and consider.

Applications. Most of the water used in the upper basin is appropriated under rights established prior to the Water Commission Act of 1914 or used under riparian rights. Since initiation of the state filing procedure in 1914, a total of 31 applications for a total diversion of 4.221 second-feet and two applications for storage of 47 acre-feet per annum have been granted licenses or permits in the Tule River watershed above Success Dam. The largest of these

diversion applications is for power purposes, 3.0 second-feet by the Pacific Gas and Electric Company, leaving applications for only 1.221 second-feet for other purposes. Four additional applications for diversion of 2.605 second-feet and 19 applications for storage of 2,482.5 acre-feet per annum were pending and had not been acted upon as of June 1959.

Seventeen of the 19 pending applications for storage total only 332.5 acre-feet and consist of 31 small farm reservoirs, all of which are existing, the largest having a capacity of 47.5 acre-feet. The other two pending applications for storage are those of Mrs. Clemmie Gill for storage of 750 acre-feet on Hickman Creek, tributary to the North Fork Tule River, for irrigation, and of the South Tule Independent Ditch Company for storage of 1,400 acre-feet on the South Fork Tule River for irrigation. The dams under the latter two applications would come under state supervision as to safety of dams.

Two applications have been made for diversion and storage at Success Dam. The first was made by the Tulare Lake Basin Water Storage District in 1945 for diversion of 2,000 second-feet and storage of 50,000 acre-feet per year. The second was made by the State Department of Finance in 1952 for diversion of 2,350 second-feet and storage of 75,000 acre-feet per year.

Nine applications have been made on the Tule River and tributaries below Success Dam, and from Tulare Lake, only one of which has been approved. The only licensed right consists of a comparatively small diversion of 6 second-feet by R. J. Gilkey from Cross Creek and Tulare Lake, filing for which was made in 1916. The unapproved applications total 5,192.5 second-feet of diversion and 1,150,000 acre-feet of storage, of which 4,500 second-feet and all of the storage have been filed on by the Tulare Lake Basin Water Storage District.

All applications, both approved and pending, filed for water from the Tule River as of June 1, 1959, are listed in Appendix B, "Applications

to Appropriate Water From the Tule River". For convenience, the applications are divided into two sections: (1) applications to appropriate water from the Tule River above Success Dam; and (2) applications to appropriate water from the Tule River from Success Dam to and including Tulare Lake.

Surface Diversions Within the Upper Tule River Basin

Water diverted in the upper Tule River Basin is utilized for agricultural, urban, recreational, and power purposes. Appendix C, "Surface Water Diversions in the Upper Tule River Basin", tabulates the quantities of water diverted in 1957, the diverters, the purpose for which the water was used, and other pertinent information. This information is summarized in the following paragraphs and Table 7.

Irrigation Use. The presently irrigated lands in the upper basin are supplied with water principally by direct diversion from the Tule River, with a relatively minor amount of surface storage. About 22,900 acre-feet of water were diverted for irrigation purposes in 1957 to irrigate approximately 3,900 acres. Insufficient flows in the Tule River and its tributaries during the summer and fall seasons limit the irrigation of additional acreage. About 700 acres that are normally irrigated were idle in 1957. Of the 4,600 acres that are normally irrigated in the upper basin, about 450 acres will be inundated by Success Reservoir.

The Pioneer Water Company diverts water from the upper Tule River into Pioneer Ditch about one mile above Success Dam for irrigation use in the Porterville area. In 1957, approximately 5,700 acre-feet were diverted. A special outlet is being provided through Success Dam in order that the use of Pioneer Ditch can continue as before.

In addition to the natural limitation on use of water, a court decree prohibits, with exception of some minor uses, diversion of water by riparian

users and appropriators upstream from Oettle Bridge during the 22-day period March 19 to April 10 of each year, unless there is 400 or more second-feet of water flowing past Oettle Bridge. Oettle Bridge is located about 12 miles downstream from Success Dam.

Urban Use. The Springville Public Utility District diverted and treated about 320 acre-feet of water in 1957 for urban use in and around the town of Springville. This water was obtained from the tailrace of the Tule Powerhouse of the Southern California Edison Company. The water supply provided by the Camp Nelson Water Company to summer homes in the Camp Nelson area was classified as a recreational use for purposes of this investigation.

Recreational Use. The Camp Nelson Water Company diverted about 150 acre-feet of water from Bishop Creek to supply about 210 summer homes in 1957. The Moorehouse Springs Fish Hatchery diverted about 700 acre-feet of water, also considered a recreational use. However, all of the water diverted by the hatchery was released for further use downstream. The Middle Fork of the Tule River is used extensively for trout fishing when flows are adequate.

Hydroelectric Power Use. At the present time there are two small hydroelectric power generating plants in the upper basin, one owned by the Pacific Gas and Electric Company, and the other by the Southern California Edison Company. Due to lack of storage facilities, power development must depend on the natural flow of the river. Both plants are located on the Middle Fork of the Tule River, which is the only branch with sufficient runoff during the dry period to make power development practical. In 1957, the two plants diverted a total of about 47,000 acre-feet of water, all of which was released for further downstream use.

TABLE 7

WATER UTILIZATION IN THE UPPER TULE RIVER BASIN IN 1957

Use	Diversion, in acre-feet
Consumptive in nature	
Irrigation	23,100
Urban	320
Recreational (summer homes)	<u>150</u>
Subtotal	23,570
Nonconsumptive in nature	
Hydroelectric power	47,080
Recreational (fish hatchery)	<u>700</u>
Subtotal	<u>47,780</u>
TOTAL	71,350

Downstream Users

The Tule River is a source of water supply for numerous individuals and the following public districts in downstream order from Success Dam: Porterville Irrigation District, Lower Tule River Irrigation District, and Tulare Lake Basin Water Storage District. The boundaries of these districts are shown on Plate 2.

Quantities of water diverted from the stream in the reach from the mouth of the South Fork downstream to Oettle Bridge for the 11-year period 1949 through 1959 are given in Table 8. The average annual quantity of water diverted was 38,200 acre-feet. Prior to 1950, the water supply of the Porterville Irrigation District was obtained from the Tule River by surface diversions and by pumping from ground water storage. Records of depth to ground water within the district indicate that the water table dropped from an average depth of 16 feet to 55 feet during the period 1921-48. Of the total drop of 39 feet, 26 feet occurred during the 1943-48 period. Increased irrigated acreage and below normal runoff were responsible for the rapid rate of depletion.

TABLE 8

TULE RIVER DIVERSIONS
(Mouth of South Fork to Oettle Bridge)

Acre-feet

Name	Mile and Bank	Year										
		1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
South Fork Tule River	0.0											
Pioneer Ditch	0.3R	5,340	6,090	5,950	9,860	4,850	4,880	5,590	5,880	6,190	7,560	3,880
Boydston Bros.	2.6L	-	-	-	-	-	-	-	-	245	364	177
Campbell-Moreland Ditch	3.2L	7,230	5,740	5,830	11,800	8,220	7,610	7,680	8,320	7,680	9,700	3,630
Porter Slough Ditch	3.2R	1,580	1,760	1,880	2,480	1,520	3,200	1,510	2,290	2,870	3,360	179
Vandalia Ditch	3.9L	1,580	1,340	2,050	2,980	2,110	1,570	1,430	1,570	1,390	1,870	799
Poplar Ditch	6.6L	8,700	8,470	9,530	15,350	7,660	12,690	10,780	17,190	14,400	22,460	4,160
Hubbs-Miner Ditch	7.2R	5,250	4,910	3,710	4,540	3,760	3,660	4,310	3,260	5,360	5,780	4,110
Rhodes-Fine Ditch	9.2L	1,470	2,090	1,340	1,550	1,520	619	515	-	-	337	421
Friant-Kern Canal	11.3											
Woods-Central Ditch	11.8L	140	4,690	-	-	-	-	704	5,970	-	19,300	-
Little Pioneer Ditch	15.0L	153	1,510	1,610	2,160	1,430	1,110	-	-	-	-	-
Oettle Bridge	15.2											

Totals 31,440 36,600 31,900 50,720 31,070 35,340 32,520 44,480 38,140 70,730 17,360

Prior to 1950, the Lower Tule River Irrigation District obtained its principal water supply by pumping from wells and by supplementing the ground water supply by surface diversion from the Tule River. Records of depths to ground water within the district indicate that the average depth to ground water increased from 22 to 83 feet during the period 1921-48. A drop of 27.5 feet occurred during the 1943-48 period, an average drop of 5.5 feet per season. Increased irrigated acreage and below normal runoff were responsible for the rapid depletion of ground water supplies.

In 1950, the Porterville and Lower Tule River Irrigation Districts began purchasing water from the United States Bureau of Reclamation. The imported water was obtained from the Friant-Kern Canal, a feature of the Central Valley Project. The quantity of water imported is shown in Table 9.

The water table has risen an average of 29 feet in the Porterville and Lower Tule River Irrigation Districts during the period 1951-58. From the spring of 1957 to the spring of 1958, the average increase in ground water levels was 3.7 feet in the Porterville Irrigation District and 2.4 feet in the Lower Tule River Irrigation District. Despite the generally rising water table, the average ground water elevation in 1958 was still 30 feet below the elevation in 1921.

The Tulare Lake Basin Water Storage District (gross area 193,000 acres) obtains its water supply from Tulare Lake and its many tributaries, including the surplus flow of Kern, Tule, and Kaweah Rivers and the portion of Kings River flow which enters through South Fork Channel. Although Tulare Lake covered an area as great as 1,000 square miles in 1880, it is now confined by levees to an area of about 40 square miles. In recent years, the lake has receded, and a large portion of the lake bed is used extensively for irrigated agriculture.

TABLE 9

WATER IMPORTED INTO THE TULE RIVER BASIN
VIA THE FRIANT-KERN CANAL, 1950-58

Year	Quantity imported, in acre-feet		
	Porterville Irrigation District	Lower Tule River Irrigation District	Totals
1950	7,415	76,074	83,489
1951	5,255	94,164	99,419
1952	8,000	153,000	161,000
1953	8,460	198,500	206,960
1954	7,868	170,000	177,868
1955	4,723	208,351	213,074
1956	7,558	262,101	269,659
1957	24,195*	244,018	268,213
1958	31,125*	247,148	278,273

* 19,190 acre-feet and 25,300 acre-feet in 1957 and 1958, respectively, were delivered outside the district.

The water supply for irrigation of the presently cropped acreage in the Tulare Lake area is generally deficient. The maximum irrigation demand is estimated at 230,000 acre-feet per year for an irrigable area of about 160,000 acres. This demand is subject to reduction in some years because of flooding, which temporarily reduces the cropped area. Water is diverted directly from all surface inflows to the area to the maximum extent available. However, the supply available for direct diversion is usually inadequate, and surplus flood waters of Tule, Kaweah, and Kern Rivers which accumulate in the Tulare Lake are utilized by gravity or by pumping to augment the supply. A large portion of such flood waters is lost by evaporation.

The Vandalia Irrigation District, a small district located about five miles southeast of Porterville, was organized in 1923 for the purpose of developing a supplemental water supply by pumping from a gravel deposit near Tule River. Water is diverted from the Tule River by the Vandalia Ditch and transported about one mile to a spreading area, where it is stored in the

underlying ground water basin. Since 1925 the basin has been replenished annually. Diversions for replenishment have averaged 1,700 acre-feet annually since 1949.

Success Reservoir

Success Reservoir, currently under construction, will be operated primarily for flood control by the United States Army Corps of Engineers. Reservations of capacity to store winter rain floods and snowmelt floods have been established, and whenever encroachment on this space occurs, water will be released up to safe channel capacities. During large floods and during exceptionally wet years, estimates indicate that some residual flood damage will still occur in the Tulare Lake area. During the snowmelt season (February 1 to July 31), reservoir operation will be based on snowmelt predictions and anticipated irrigation diversions, with the general objectives of not exceeding downstream channel capacities and eliminating or minimizing damaging flow into Tulare Lake.

Water conservation at Success Reservoir for irrigation use will be subject to storage requirements for flood control. Irrigation interests participating in the project will be allowed to store water in the reservoir and have it released on demand, as long as such storage does not conflict with flood control reservations or operation. The 80,000 acre-feet of storage capacity in the reservoir will be utilized as follows: 75,000 acre-feet will be available for flood control and irrigation storage, and 5,000 acre-feet of space in the reservoir will be reserved for silt storage and for recreational uses. The 75,000 acre-feet of storage can be used at times for both flood control and irrigation, as waters stored to prevent flood damage can often be released later for irrigation use. This is particularly true of snowmelt runoff, because the reservoir can be safely filled near the end of the precipitation season.

The Corps of Engineers has determined that flood control accomplishments would consist of reducing flood damage along the Tule River and in Tulare Lake Basin. Tulare Lake Basin has been divided by levees into a large number of cells. All but the central cell are cultivated and used for crops when not flooded. During the period of analysis, 1904-55, Tule River flood flows would have caused damage in only six years had Success Reservoir been in operation.

Studies by the Corps of Engineers indicate that Success Reservoir would aid irrigated agriculture by developing new water and by reregulating the existing supply so that it can be used more effectively for crop requirements. The new water would be obtained by reducing evaporation from Tulare Lake, and the quantity would vary greatly from year to year. The estimated annual amounts of new and reregulated water are 6,600 and 19,200 acre-feet, respectively. Downstream users have or claim rights to all the irrigation water to be stored in the reservoir.

Water Requirements

Estimates of water requirements for irrigation, urban, and recreational purposes in the upper Tule River Basin are presented in this section. In general, estimates of water requirements were based on unit values of consumptive use and the present and probable ultimate patterns of land use.

Irrigation Water Requirements

Determination of irrigation water requirements was based on unit values of consumptive use of applied water for the various crops grown in the area, and the efficiency with which water is or would be applied to the land. The unit values of consumptive use of applied water used in this bulletin are those presented in State Water Resources Board Bulletin No. 2, "Water Utilization and Requirements of California", June 1955.

An average value of consumptive use for irrigated lands in the upper Tule River Basin was determined from the crop pattern observed in 1957. At that time, about 70 percent of the land irrigated in the upper basin was pasture. Assuming that the seasonal consumptive use of applied water on pasture land was about 3.1 acre-feet per acre, and that seasonal consumptive use on the other 30 per cent of the irrigated lands averaged 2.1 acre-feet per acre (which is the quantity of water consumed by deciduous and citrus orchards), the weighted average seasonal consumptive use of applied water was about 2.8 acre-feet per acre.

In the period from April 1957 through March 1958, about 23,100 acre-feet of water were diverted to irrigate about 3,900 acres, an average unit diversion of 5.9 acre-feet per acre. The computed irrigation efficiency is about 50 percent. However, because of redirection and nongrowing season diversions within the basin, the actual upper basin efficiency is undoubtedly higher.

The cost of developing future water supplies for the irrigation of additional land would undoubtedly be considerably higher than the present cost. It is believed that lands brought under irrigation in the future would be utilized largely for orchard crops and other high-income producing crops. As a result, irrigation efficiency is expected to increase to around 75 percent.

It was assumed that 90 percent of the new irrigated area will be orchards with a unit seasonal consumptive use of applied water of 2.1 acre-feet per acre, and 10 percent alfalfa with a unit seasonal consumptive use of 3.1 acre-feet per acre. The weighted seasonal consumptive use of applied water would be 2.2 acre-feet per acre. Applying the assumed irrigation efficiency of 75 percent, a unit irrigation requirement of 2.9 acre-feet per acre per season was derived for additional land brought under irrigation in the future. This unit requirement and the 11,000 acres of irrigable, but as yet unirrigated,

land was used to estimate future irrigation water requirements in the upper basin. It was assumed that presently irrigated lands would retain their present diversion rights. Table 10 summarizes the irrigation water requirements.

TABLE 10
PRESENT AND PROBABLE ULTIMATE
SEASONAL IRRIGATION WATER REQUIREMENTS
IN THE UPPER TULE RIVER BASIN

Stage of development	Irrigation water requirements, in acre-feet
Present	23,000
Ultimate	55,000

An additional amount, approximately 32,000 acre-feet of new water, would be required seasonally for irrigated agriculture under conditions of ultimate development. However, the stream would be depleted only to the extent of the consumptive use and irrecoverable losses incidental thereto, approximately 23,000 acre-feet per season. Thus, the efficiency at which land would be irrigated in the future would be important with regard to possible exchange agreements with present downstream water users.

Urban Water Requirements

The ultimate seasonal unit water requirement for urban use was estimated at 2.6 acre-feet per acre in Bulletin No. 2, and the same value was utilized in this study. It is noted that in 1957, the Springville Public Utility District diverted about 322 acre-feet to serve a gross area of 242 acres, about 1.3 acre-feet per acre. However, the area is only partially developed, and it was assumed that 2.6 acre-feet per acre would be required per season under conditions of ultimate development.

About 550 acres are projected for urban use in the future. The probable ultimate urban seasonal water requirement in the upper basin, as derived from the above values, was estimated to be 1,400 acre-feet.

Recreational Water Requirements

Unit values of water use for recreational purposes in the upper Tule River Basin were obtained by considering the number of user-days for each category of recreational activity, the quantity of water used, and the probable ultimate pattern of land use. Wilderness areas were assumed to have a negligible water requirement. The total ultimate seasonal recreational water requirement for the upper basin was estimated to be 2,000 acre-feet.

Supplemental Water Requirements

Supplemental water requirements, as used in this bulletin, are the difference between estimated ultimate water requirements and present water requirements. Table 11 summarizes present, ultimate, and supplemental water requirements for the upper basin.

TABLE 11
SUPPLEMENTAL SEASONAL WATER REQUIREMENTS
FOR THE UPPER TULE RIVER BASIN
(In acre-feet)

Water requirements	Purpose			Total
	Urban	Recreational	Irrigation	
Present (1957)	300	200	23,100	23,600
Ultimate	1,400	2,000	55,000	58,400
Supplemental	1,100	1,800	31,900	34,800

Monthly Demands for Water

The present monthly distribution of annual water use for irrigation and other purposes is largely dependent upon the regimen of Tule River and its tributaries, since water for irrigation purposes comprises the major use and existing supplies are unregulated. A large quantity of water is diverted during the early spring months when water supply conditions in the Tule River and its tributaries are generally good. As the runoff dwindles, the diversions for irrigation decrease accordingly.

Under future conditions, the monthly distribution was assumed to be similar to irrigation and urban use in the Visalia-Delano area, as shown in Water Resources Board Bulletin No. 2. Table 12 shows the monthly distribution of annual water demand assumed to exist under conditions of ultimate development.

TABLE 12
MONTHLY DISTRIBUTION OF ANNUAL WATER DEMANDS

Month	Percent	Month	Percent
January	2.0	July	13.3
February	1.6	August	16.5
March	3.0	September	16.4
April	6.5	October	12.0
May	8.6	November	6.0
June	9.6	December	<u>4.5</u>
		TOTAL	100.00

CHAPTER IV. AVAILABILITY OF WATER

An essential step in planning a water resources development is a determination of the location and amount of unappropriated water.

Existence of Water Available for Development in the Upper Tule River Basin

Previous reports of the Department of Water Resources have consistently indicated that there is no unappropriated water in the Tule River, except in occasional flood years. "Water Resources of Tulare County and Their Utilization", published in 1922 by the Department of Public Works, did not recommend construction of conservation storage on the Tule River without exchange of import water on the valley floor, since it was concluded that such storage would mainly result in a change in method of use, and would not make available any materially larger part of the runoff than was then used.

Office Report No. 2(b), "Tule River-Deer Creek Area in Tulare County", published in 1940 by the State Water Project Authority, included a conclusion to the effect that about one-third of the average seasonal water requirements during the 18-year period 1921-39 was derived by depleting ground water supplies.

In the California Water Plan, as presented in Department of Water Resources Bulletin No. 3, May 1957, it was stated that it would be necessary to substitute imported water for valley floor lands under a negotiated exchange agreement if upstream reservoirs were to be constructed on the Tule River for the purpose of developing additional water for the area above Success Reservoir.

An analysis of the flood flows entering Tulare Lake supports the contention that only on rare occasions do appreciable quantities of unappropriated water exist in the Tule River. Table 13 shows the flow in the Tule River at a stream gaging station near the edge of the valley (Worth Bridge

TABLE 13
 RUNOFF OF TULE RIVER AT
 WORTH BRIDGE AND TURNBULL GAGING STATION

(In acre-feet)

Season	Tule River at Worth Bridge	Turnbull Station		
		Total Runoff	Runoff from Elk Bayou	Runoff from Tule River*
1942-1943	-	181,400	47,400	134,000
1944	-	150	700	0
1944-1945	205,600	54,400	23,300	31,100
1946	92,400	9,600	5,300	4,300
1947	49,700	20	660	0
1948	59,800	340	1,400	0
1949	43,600	0	0	0
1949-1950	58,400	0	60	0
1951	131,000**	13,400	6,900	6,500
1952	310,000	104,800	34,100	70,700
1953	93,000**	9,800	2,800	7,000
1954	84,400	0	-	0**
1954-1955	58,300	80	-	0**
1956	204,600	57,900	23,800**	34,100**
1957	59,500	760	-	0**

* Determined by subtracting the runoff from Elk Bayou from the total runoff recorded at Turnbull Station.

** Estimated.

gaging station) and at a downstream gaging station near Tulare Lake (Turnbull gaging station) for the period 1943-57. The latter station was located 1,200 feet downstream from the Corcoran-Angiola Highway Bridge, about 37 miles downstream from Success Dam. This station measured the inflow to the Tulare Lake area and included water from the Kaweah River (via Elk Bayou) and the Tule River. Runoff from Elk Bayou was subtracted from the total runoff at Turnbull Station to determine the runoff from the Tule River.

When the seasonal flow remaining in the Tule River at Turnbull Station was relatively small, say less than 10,000 acre-feet, there was essentially no unappropriated water in the river. This condition existed in 11 out of the 15 water years between 1943 and 1957. In two of the remaining seasons, 1945 and 1956, Tulare Lake had sufficient storage capacity to contain the flows, and they were therefore claimed by the Tulare Lake Basin Water Storage District. In two years, 1943 and 1952, there may have been unappropriated water. With the Kern River and Kings River now regulated by large flood control reservoirs, namely, Isabella and Pine Flat, it is probable that the 1952 flow in the Tule River could have been contained in Tulare Lake without undue damage. This leaves only the year 1943 in which there would have been some unappropriated water. Flows in the Tule River equal to or exceeding those of 1943 are estimated to have occurred only five times in the last 65 years. Therefore, substantial quantities of unappropriated water do not exist in the Tule River except in occasional flood years, occurring, on the average, less than once in ten years.

Exchange Possibilities

Since substantial quantities of unappropriated water do not exist in the Tule River and tributaries except in occasional flood years, future water supply development for irrigation in the upper basin must be largely contingent

upon possible exchange with downstream users. Domestic and urban supplies can usually be expanded as needed, because of the relatively small quantities involved and because of the higher water right priority assigned to domestic use by law. Agencies proposing development of significant additional irrigation supplies in the upper basin, however, will probably have to bear the cost of providing exchange water to downstream users. Sources of water for exchange are discussed in the following paragraphs.

Existing Ditch Companies

Shares in certain ditch companies along the Tule River below Success Dam are available for purchase. There is the possibility that upper basin water users could purchase these shares and thereby effect an estoppel against the subsequent exercise of the claim to water for these shares. If none of these shares have claims of riparian rights, there is also the possibility that the point of diversion and place of use for these rights could be transferred upstream, provided the water can be used by direct diversion without storage and that no other water rights are adversely affected. The latter condition would probably be difficult to achieve because of the nearly complete beneficial use of the natural flow of the river in this area.

Friant-Kern Canal

Interim supplies of surplus water may be available for purchase from the U. S. Bureau of Reclamation via the Friant-Kern Canal in years of above-average runoff, because some of the participating districts are not fully developed. These districts are not, under the terms of their contracts, presently diverting their maximum quantities of water. Although there were, as of January 1, 1959, about 50 applicants for such surplus water, only a portion of these applicants could handle significant quantities of water in the months when it is available, primarily, February through May.

The Bureau of Reclamation estimated in 1958 that with repetition of the runoff conditions of the past 60 years, and with the projected use of the Millerton Lake water supply by long-term contractors, an average season surplus of 250,000 acre-feet would be available during the next five years. Based on the historical runoff record, there would be no surplus in half of the years, while up to 700,000 acre-feet of surplus water would be available for delivery in wet years. Historically, there have been several continuous four-year periods during which no surplus water would have been available.

In previous years, this surplus water has been sold by means of temporary one-year contracts. The Bureau of Reclamation now proposes to contract for the potential surplus supply over a five-year period. About 20 such short-term contracts have been executed. The price charged for surplus spring water is \$1.50 per acre-foot and for surplus summer water is \$3.50 per acre-foot.

As the districts with long-term contracts increase their purchases of water from the Friant-Kern Canal, the surplus water available for short-term contracts would decrease. It is estimated that surplus water would be available only in the wetter years after approximately 15 years. It is possible, however, that additional surpluses may become available with the construction of additional units of the Central Valley Project.

Another possible source of short-term exchange water, closely related to the surplus water supplies of the Bureau of Reclamation just discussed, is the surplus water of certain districts which hold long-term contracts with the Bureau. These districts are not able to use their minimum contract commitments. The Porterville Irrigation District, for example, sold 25,300 acre-feet to other districts in 1958. Surplus water is offered by the Bureau of Reclamation first to long-term contractors, then it may be offered

to short-term contractors, and finally to any other agricultural users. The execution of a short-term contract by upper basin users would therefore increase the possibility of obtaining surplus water. Upper basin users could possibly purchase such water for release down the Tule River to replace the amount of depletion resulting from use of water in the upstream areas.

Any of the foregoing means of obtaining Friant-Kern water for exchange would provide only a temporary supply. There is no further firm Friant-Kern water available for purchase on a long-term basis.

Success Reservoir

The Corps of Engineers has determined that the new yield of Success Reservoir will average 6,600 acre-feet annually, obtained primarily from reduction in evaporation from Tulare Lake. However, there was a 20-year period in the operation study, 1916 through 1935, during which there would have been no new yield. Therefore, it would not be practicable to firm up this new water through storage upstream unless other sources of exchange water were available during extended dry periods. It may be possible for upper basin users to purchase some of the new irrigation yield from Success Reservoir to use for exchange in conjunction with other sources, and thereby permit upstream development.

A rough indication of the cost of water from Success Reservoir was obtained from the Corps of Engineers' cost allocation study dated July 12, 1956. The Bureau of Reclamation, which will negotiate contracts with water users for repayment of conservation benefits, has stated that this cost allocation will govern the price of the water. Costs allocated to irrigation were 9.5 percent of the total cost. Presuming a total cost of about \$14,200,000, costs allocated to irrigation would be about \$1,350,000. Total new and redistributed water from Success Reservoir would average

approximately 25,800 acre-feet seasonally. Since there is no practical method of distinguishing new and reregulated water in reservoir operation, Bureau of Reclamation officials have stated that all irrigation water would be charged at the same rate for storage at the reservoir. The annual cost allocated to irrigation would be about \$52,000, including operation, maintenance, and replacement, or about \$2 per acre-foot of water stored at the reservoir for irrigation.

San Joaquin Valley-Southern California Aqueduct

The Legislature of the State of California has authorized construction of the San Joaquin Valley-Southern California Aqueduct, which will pass several miles west of Tulare Lake. Initial water delivery from this aqueduct to the general area is scheduled for 1968. It may be possible for upper Tule River Basin water users to contract for aqueduct water for exchange with the Tulare Lake Basin Water Storage District for Tule River water. The cost of water at canalside has been computed as about \$14 per acre-foot for this reach of the aqueduct.

East Side Division of the Central Valley Project

The Bureau of Reclamation is currently planning an East Side Division of the Central Valley Project which would transfer water from the Sacramento Valley to the San Joaquin Valley by detouring past the delta on the east. Construction of such a canal is believed to be at least 10 years in the future. A distributing canal, tentatively planned for about the 600-foot elevation in the Porterville-Bakersfield area, would be higher than all of the diversion points along the Tule River below Success Dam. It may be possible for upper basin users to contract for exchange water on a permanent basis when the East Side Division supply becomes available.

The Bureau of Reclamation's published information regarding the East Side Project has not presented cost figures for the water.

CHAPTER V. PLANS FOR DEVELOPMENT OF BASIN STORAGE

Preliminary plans are presented herein for facilities that could store and distribute sufficient water to satisfy the ultimate supplemental water requirements of some of the land classed as irrigable, urban, or recreational in the upper Tule River Basin. Consideration was given to yield of water, size of dam, availability of construction materials, and assumed right of way costs in the selection of a reservoir site on each fork of the Tule River. However, these plans are preliminary in nature, and future investigations may indicate the desirability of modifications in the size, type, and location of structures. The quantity of storage found feasible may also be limited by exchange agreements with present downstream users of the water.

Capital costs of dams, reservoirs, diversion works, conduits, pumping plants, and appurtenances were estimated from preliminary designs, based largely on data from reconnaissance surveys made during this investigation, from office studies using aerial photographs and U. S. Geological Survey quadrangle maps, and from information gathered from other agencies. Quantities of construction materials were estimated from these preliminary designs. Unit prices of construction items were determined from recent bid data on projects similar to those in question, or from manufacturers' cost lists, and are considered representative of prices prevailing in July 1959. The estimates of capital costs include costs of rights of way and construction, plus 10 percent for engineering, and 25 percent for contingencies. Estimates of annual costs include amortization of the capital investment over a 50-year period at 4 percent interest, operation, maintenance, and replacement.

With anticipated continued growth of population in California, it is expected that the public demand for preservation and enhancement of recreational facilities will be sufficient to assure provision of the water supplies necessary to satisfy this demand. In the aggregate, the amount of water consumptively used in recreational areas of the upper basin would be relatively minor. The incidental use of water developed for other purposes, for boating, swimming, and other water sports would not add to consumptive use, and would be compatible with the primary uses. Of considerable importance among the employments of water for recreation would be those associated with the preservation and propagation of fish and wildlife.

In connection with the ensuing discussion of water development facilities, the following terms are used as indicated.

Safe Yield. The maximum sustained rate of draft from a reservoir that could have been maintained through a critically deficient water supply period to meet a given demand of water. For purposes of this report, safe yield was determined on the basis of the critical period that occurred in the upper basin from 1927 through 1931.

New Seasonal Irrigation Yield. The maximum sustained rate of draft from a reservoir that could have been maintained through a critically deficient water supply period to meet a given irrigation demand for water with certain specified deficiencies. For purposes of this report, irrigation yield was determined on the basis of the critical period that occurred in the upper basin from 1927 through 1931, and the specified deficiency was assumed to be 35 percent for one year during the five-year

study period. The water is "new" only in relation to present use in the upper basin. The same water is now used in the lower basin.

The plans described herein to store and distribute water in the upper Tule River Basin include a dam and reservoir on the North, Middle, and South Forks of the Tule River, and the pumping of water from Success Reservoir. The possibility of obtaining additional runoff by converting brushland to range land is also discussed. Locations of principal features of the plans are shown on Plate 3, "Possible Development".

North Fork Project

The North Fork Project would include the construction of North Fork Dam and Reservoir on the North Fork of the Tule River. The dam would be located about 4 miles northeast of Springville in Section 23, Township 20 South, Range 29 East, M.D.B.&M. The stream bed elevation at this point is about 1,280 feet. The project would conserve water for irrigation and domestic use in the vicinity of Springville and in Pleasant Valley. It would also furnish recreational and stream flow enhancement benefits.

Storage capacities of the North Fork Reservoir at various water surface elevations were determined from the Geological Survey quadrangle map with a scale of 1 to 24,000 and a contour interval of 40 feet. Topographic data for the preliminary design of the proposed dam were taken from the same map and aerial photographs. Storage capacities of North Fork Reservoir and areas inundated at various water surface elevations are shown in Table 14.

TABLE 14

AREAS AND CAPACITIES OF NORTH FORK RESERVOIR

Depth of water at dam, in feet	Water surface elevation, in feet U.S.G.S. datum	Water surface area, in acres	Storage capacity, in acre-feet
0	1,280	0	0
40	1,320	40	800
80	1,360	130	4,200
120	1,400	220	11,200
160	1,440	386	23,400
200	1,480	615	43,400

The runoff from the approximately 90-square-mile watershed above the dam site was estimated for each month from January 1927 to August 1936. The estimates of runoff gave consideration to water diverted for use in the upper basin and hence reflect net water supply values, as far as the upper basin is concerned. Monthly demands on the reservoir were assumed to have the percentage distribution shown in Table 12. Based on these net runoff estimates during the critical dry period, 1927 through 1931, new seasonal irrigation yields were estimated for various reservoir sizes. Storage-yield curves were developed for reservoir capacities, ranging from 3,200 acre-feet to 38,000 acre-feet. New seasonal irrigation yield ranged from 2,000 acre-feet to 18,800 acre-feet.

Based on service area requirements, as discussed later herein, and preliminary estimates of least cost per acre-foot of new seasonal yield, a reservoir with a capacity of 22,000 acre-feet was selected to illustrate the North Fork Project.

Preliminary geological reconnaissance indicates that the North Fork Dam site is suitable for an earthfill dam. Both abutments appear to be firm granitic rock. It was estimated that about 5 feet of stripping would be necessary on the abutments and about 25 feet on the channel section. Ample

quantities of alluvial materials and rock appear to be available near the site. The left abutment appears best suited for the location of a spillway.

For cost estimating purposes, it was assumed that an impervious core with a rockfill section on each side would be constructed at this site. The impervious zone would be adequately protected by transition zones and gravel drains. The dam would have a slope of 2.2 to 1 on the upstream face, 2.0 to 1 on the downstream face, and a crest width of 20 feet.

The spillway would be located on the left abutment and would have a discharge capacity of 49,000 second-feet. It would have an uncontrolled overflow weir with a crest length of about 280 feet. Although subsurface exploration might disclose that an unlined spillway could safely be constructed, it was assumed for cost estimating purposes that concrete lining would be required. Except for stripping, material to be excavated from the spillway was assumed to be suitable for use in the dam. The spillway would discharge into the North Fork of the Tule River below the dam. The maximum depth of water above the spillway lip would be 14 feet, and an additional 5 feet of freeboard would be provided.

The outlet works would consist of a submerged inlet structure, a concrete-encased steel pipe leading to a valve chamber located beneath the crest of the dam, and a 7-foot diameter cut and cover section which would provide access to the valve chamber and house the steel outlet pipe. A butterfly valve would control the discharges at the downstream end of the outlet works.

Construction of North Fork Dam and Reservoir would require the relocation of a portion of Balch Park Road. For cost estimating purposes, the road was relocated around the right abutment of the dam, the length varying according to the height of the dam. Right of way costs for road relocation are included in the total cost estimates.

The estimated cost of a 22,000 acre-foot reservoir, based on July 1959 prices, is \$6,037,000. The annual cost, including interest at 4 percent per annum over a 50-year amortization period, would be \$290,000. The reservoir would develop a new seasonal yield of about 14,500 acre-feet at a cost of about \$20 per acre-foot.

The above costs do not include conveyance and distribution costs, or costs of exchange water on the valley floor. However, the annual costs include operation and maintenance costs for the dam and appurtenant works.

Middle Fork Project

The Middle Fork Project would include the construction of Mahogany Flat Dam and Reservoir on the South Fork of the Middle Fork of the Tule River. The dam would be located about 2 miles west of Camp Nelson in Sequoia National Forest. The stream bed elevation at this point is about 3,940 feet. The reservoir would conserve water which could be made available to lands in the vicinity of Springville, and would also be highly valuable for recreational use and stream flow enhancement. The Middle Fork of the Tule River is intensively used for fishing and recreation, but this use is usually restricted by very low flows in late summer months.

Topographic data for determination of storage capacities of the Mahogany Flat Reservoir and areas flooded at various water surface elevations were taken from the Geological Survey Camp Nelson quadrangle map with a scale of 1 to 62,500 and a contour interval of 80 feet. Topographic data for preliminary designs of the proposed dams were taken from an enlargement of the same map and aerial photographs. Storage capacities of Mahogany Flat Reservoir and the areas inundated at various water surface elevations are shown on Table 15.

TABLE 15

AREAS AND CAPACITIES OF MAHOGANY FLAT RESERVOIR

Depth of water at dam, in feet	Water surface elevation, in feet U.S.G.S. datum	Water surface area, in acres	Storage capacity, in acre-feet
0	3,940	0	0
60	4,000	20	600
140	4,080	38	2,800
220	4,160	87	7,800

The runoff from the approximately 31-square-mile watershed above the dam site was estimated for each month from January 1927 to August 1936, utilizing runoff records at nearby gaging stations. The estimates of runoff gave consideration to water diverted for use in the upper basin, and hence, reflect net water supply values. Monthly demands on the reservoirs were assumed to have the percentage distribution shown in Table 12. Storage-yield curves were developed for reservoir capacities, ranging from 1,400 acre-feet to 3,800 acre-feet. The 1,400 acre-foot reservoir was selected to illustrate the Middle Fork Project.

Based on preliminary geological reconnaissance and aerial photographs, the Mahogany Flat Dam site appears suitable for an earthfill dam. The foundation appears to be either metamorphic or igneous rock. Limestone beds were found, and the reconnaissance indicated that a careful geological investigation should be made of any proposed dam and reservoir in the area, inasmuch as limestone is, in many cases, cavernous.

It was estimated that about 5 feet of stripping would be necessary on the abutments and about 10 feet in the channel section. Ample quantities of decomposed granite are available within 5 miles of the site, and rock is available near the site. The right abutment appears best suited for the location of the spillway.

Cost estimates were based on an impervious section with random rock sections on each side. The impervious section would be adequately protected by transition zones and gravel drains. The dam would have a slope of 2.2 to 1 on the upstream face, a slope of 2.0 to 1 on the downstream face, and a 20-foot wide roadway on the crest.

The spillway would have a crest length of about 60 feet and would extend across the right abutment. It would have a discharge capacity of 17,000 second-feet. The maximum depth of water above the spillway lip would be 20 feet, and an additional 5 feet of freeboard would be provided. The spillway would be lined for its full length and would discharge into the South Fork of the Middle Fork of the Tule River below the dam.

The outlet works would include a submerged inlet structure and a steel pipe leading to a valve chamber located beneath the crest of the dam. The steel pipe would be placed in a trench excavated in the right abutment beneath the dam, and would be encased in concrete. Access to the valve chamber would be provided by a cut and cover section extending from the valve chamber to the downstream control valve which would contain the outlet pipe.

Preliminary estimates indicate that a 1,400 acre-foot reservoir on the South Fork of the Middle Fork of the Tule River could provide about 2,200 acre-feet of new seasonal irrigation yield at a cost of about \$29 per acre-foot. The reservoir would enhance the recreational potential of the area. Capital costs of the dam and appurtenant structures are estimated at \$1,146,000. Annual costs, including interest at 4 percent per annum over a 50-year amortization period, would be \$64,000. Costs of distribution and of purchase of exchange water are not included in the foregoing figure.

South Fork Project

The South Fork Project would include the construction of Indian Gate Dam and Reservoir on the South Fork of the Tule River. The dam would be located about 6 miles southeast of Success Dam in the southwest corner of Section 11 and the northwest corner of Section 14, Township 22 South, Range 29 East, M.D.B.&M. The stream bed elevation at this point is about 900 feet. The project would conserve water which could be made available to lands along the South Fork and possibly in Pleasant Valley. It would also provide recreational and stream flow enhancement benefits.

Topographic data for determination of storage capacities of the Indian Gate Reservoir at different water surface elevations, together with the areas flooded, were taken from a Geological Survey quadrangle map with a scale of 1 to 24,000 and a contour interval of 40 feet. Topographic data for preliminary designs of the proposed structures were taken from an enlargement of the same map and aerial photographs. Storage capacities of Indian Gate Reservoir and areas inundated at various water surface elevations are shown in Table 16.

TABLE 16

AREAS AND CAPACITIES OF INDIAN GATE RESERVOIR

Depth of water at dam, in feet	Water surface elevation, in feet U.S.G.S. datum	Water surface area, in acres	Storage capacity, in acre-feet
0	900	0	0
20	920	3	30
60	960	40	850
100	1,000	110	3,800
140	1,040	210	10,000
180	1,080	340	21,000
220	1,120	490	37,000

The runoff from the approximately 93-square-mile watershed of the South Fork of the Tule River above the dam site was estimated for each month from January 1927 to August 1936. The estimates of runoff gave consideration to water diverted for use in the upper basin, and hence, reflect net water supply values.

Irrigation yield studies were based on estimates of runoff for the critically dry period of 1927 through 1931. Monthly demands on the reservoir were assumed to have the same percentage distribution as shown in Table 12. A 3,200-acre-foot reservoir would yield about 2,000 acre-feet and a 39,000-acre-foot reservoir would yield about 14,500 acre-feet of new water seasonally.

A reservoir with a capacity of 6,500 acre-feet and a yield of 6,000 acre-feet was selected on the basis of least cost per acre-foot of new seasonal irrigation yield and service area requirements, as discussed later herein.

The Indian Gate dam site is considered suitable for an earthfill dam. Both abutments consist of schistose metamorphic rock with foliation striking approximately parallel to the axis of the dam and standing nearly vertical. It was estimated that about 2 feet of stripping would be necessary for the abutments and about 25 feet for the channel section. Ample quantities of decomposed granite and rock are available near the site. The right abutment appears best suited for the location of a spillway.

Cost estimates were based on a preliminary design, using an impervious section with random rock sections on each side. The impervious zone would be adequately protected by transition zones and gravel drains. The dam would have a slope of 2.2 to 1 on the upstream face, a slope of 2.0 to 1 on the downstream face, and a crest width of 20 feet.

A spillway with a discharge capacity of 29,000 second-feet would extend across the right abutment. The crest would be about 275 feet in length.

The maximum depth of water above the spillway lip would be 10 feet. An additional 5 feet of freeboard would be provided. A concrete weir would discharge flood water into an unlined channel for conveyance to the South Fork of the Tule River below the dam. Except for stripping, material to be excavated from the spillway was assumed to be suitable for use in the dam.

The outlet works would include a submerged inlet structure, trashracks, and a steel pipe leading to a valve chamber located beneath the crest of the dam. The steel pipe would be placed in a trench excavated in the right abutment beneath the dam and would be encased in concrete. From the valve chamber, a steel pipe, placed in a 7-foot diameter concrete cut and cover section, would discharge into the river. A butterfly valve would control the releases.

Construction of Indian Gate Dam and Reservoir would necessitate relocation of the road to the Tule River Indian Reservation. Costs of road relocation and rights of way are included in the cost estimates. The reservoir area in the Indian Reservation is not intensively developed, and representatives of the U. S. Bureau of Indian Affairs have indicated that rights of way could be negotiated.

The estimated cost of a 6,500-acre-foot reservoir, based on July 1959 prices, is \$1,401,000. The annual cost, including interest at 4 percent per annum over a 50-year amortization period, would be \$74,000. The reservoir would develop a seasonal yield of about 6,000 acre-feet at a cost of about \$12 per acre-foot. Preliminary cost estimates made for other reservoir sizes at this site indicate that the cost per acre-foot of new seasonal irrigation yield for reservoirs between 6,500 and 39,000 acre-feet would vary between \$12 and \$18 per acre-foot. The costs of distribution and of exchange water would be added to the foregoing costs.

Pumping From Success Reservoir

A brief study was made to determine the cost of providing a supplemental water supply for the upper basin by pumping from Success Reservoir. The plan would require pumping plants, force mains, and a distribution system. In addition, permission from the Federal Government to store the water in Success Reservoir for agricultural use during the irrigation season would be necessary.

For cost estimating purposes, the presently irrigated area along the South Fork of the Tule River was selected as a study area. The annual costs per acre-foot were estimated to be: pumping facilities, \$6; energy for pumping, \$10; conveyance and distribution, \$5. It was assumed that permission to store water in Success Reservoir could be obtained at a cost of \$2 per acre-foot, making a total unit cost of about \$23 per acre-foot. This cost does not include the cost of purchasing water on an exchange basis from downstream appropriators in those years when new water would be unavailable in Success Reservoir.

While the cost of obtaining a supplemental water supply from Success Reservoir appears comparable to the cost of water from the North and South Fork Projects, it should be emphasized that since the primary purpose of Success Reservoir is flood control, permission to store water may not be obtainable. Also, water stored in the North or South Fork Projects could be used for stream enhancement and recreation; whereas, water obtained from Success Reservoir would not be available for such uses.

Land Management

Local leaders of the Tule River Soil Conservation District have expressed a strong interest in the possibility of increasing runoff in certain of the lower brushlands of the upper Tule River Basin by removing brush and

replacing it with grass. The possibility of improving range land should be considered the strongest inducement in this regard, with the possibility of increasing runoff as a by-product.

The Department of Water Resources is cooperating with the University of California in studies of the effects of such manipulation of vegetation on several small watersheds in the foothills of the Coast Range and Sierra Nevada. In these studies to date, increases in annual water yield of as much as 10 inches in depth, or 533 acre-feet per square mile, have been measured under favorable conditions without serious acceleration of soil erosion. However, these results are based on limited data, and the department cannot attest to their applicability to large areas.

There are several limitations on the practicability of brush clearing. In the case of shallow soils, which is likely to be the case in the area being considered, many grasses will extract about as much soil moisture as the existing brush, resulting in little or no increase in water yield. In some areas, particularly on the steeper slopes, removal of the brush cover may decrease infiltration rates to such an extent that flash flooding and severe erosion problems would occur. Therefore, it would probably be only on the deeper soils with flatter slopes where a savings of water could be demonstrated without severe flooding and erosion. Research by the U. S. Forest Service in Idaho has indicated that the limiting slope is 30 percent. With slopes greater than 30 percent, the small reduction in total evaporation and transpiration losses from burned plots is achieved at the expense of greatly increased flash flows of silt-laden water. The limiting factors of soils and slopes, above which the potential hazards outweigh the potential grazing and water gains, may narrow the area of potential benefit from brush clearing to rather small proportions. A limited amount of clearing in carefully selected areas on a

trial basis would be desirable. The experience thus gained should help evaluate the desirability of widespread conversion of brushlands to grassland in this area.

Careful study of the University of California, College of Agriculture, publication entitled, "Improving California Brush Ranges", by R. M. Love and B. J. Jones, is recommended for those contemplating brush clearing. It should be particularly noted that before fire is used, the details of the operation should be worked out in accordance with requirements and suggestions of representatives of the State Division of Forestry. A permit to burn at a stated time and place must be obtained from the local State Forest Ranger.

Distribution System

The cost of transporting and distributing water to irrigable lands varies considerably, depending upon the distance water must be transported, the terrain, the type of soil, and the availability of construction materials. A review of distribution system cost estimates in previous reports indicated that the combined transportation and distribution cost would be about \$5 per acre-foot per year.

Repayment Capacities

The limited scope of this reconnaissance investigation did not warrant a detailed study to determine the capacities for repayment of water costs of the various crops that may be produced on the irrigable lands in the upper basin. However, the department has made detailed studies to determine the repayment capacity of the same crops in the other parts of the state, some of which include areas with climate and soil conditions similar to those found in the basin. Based on these studies, it is estimated that orchards and truck crops produced in the basin would have a repayment capacity ranging from about

\$15 to \$30 per acre-foot, and that irrigated pasture would have a capacity between \$5 and \$8 per acre-foot of water used. In general, crops that could be produced on irrigable lands in the upper basin that are not irrigated at the present time may tend to have repayment capacities nearer the lower limits mentioned above because of the type of soil and the topography.

Service Areas

Service areas that could be economically supplied with water from proposed projects in the upper Tule River Basin were determined by assuming elevation limits on the irrigable lands. In selecting the areas, consideration was given to the cost of water from each project, the general topography, land class, presently irrigated lands, and existing irrigation systems.

The most practical service area for the North Fork Project appears to be the Springville-Pleasant Valley area. This would include all irrigable land north of the Tule River between the 652-foot contour (the spillway elevation of Success Reservoir) and the 1,300-foot contour and east of the ridge in Section 13, Township 21 South, Range 28 East. Also included would be the lands south of the Tule River and east of Success Reservoir that are presently irrigated. The service area would include about 7,600 acres of irrigable land, of which 3,500 acres were irrigated in 1957. The area would also include about 550 acres classed as urban and 60 acres classed as recreational. The supplemental requirement for the service area would be about 14,500 acre-feet.

No service area was delineated for the Middle Fork Project because of the high unit cost of water. It is possible that at some time in the future the recreational benefits of a reservoir on this stream will be sufficient to make this project feasible.

The area selected for the South Fork Project would include irrigable lands along the South Fork of the Tule River between the 652-foot and 1,000-

foot contours. The area includes 2,700 acres of irrigable land, of which about 700 acres were irrigated in 1957. The supplemental water requirement for the service area would be about 6,000 acre-feet per year.

The irrigable area within the elevation limits described above contains about 2,100 acres of valley land and 8,200 acres of hill land for a total irrigable area of 10,300 acres. In addition, the area contains about 550 acres of land forecast for urban development and about 60 acres forecast for recreational purposes.

The aggregate reservoir storage capacity of about 28,500 acre-feet provided by the North and South Fork Projects would yield approximately 20,500 acre-feet per season, the quantity required for full development of the selected service areas.

Lands in Pleasant Valley south of the Tule River and east of Success Reservoir that are not presently supplied by existing ditches could be included in the South Fork Project service area. Since the unit cost of water from the North Fork Project would be about \$8 more per acre-foot than water from the South Fork Project, water could be conveyed into Pleasant Valley from the South Fork Project at costs up to this amount before an economic balance is reached.

Summary of Plans For Development

The supplemental water requirement for the North Fork Project service area would be about 14,500 acre-feet seasonally. This would require a 22,000 acre-foot reservoir, which would cost about \$6,000,000. Annual costs of water at the reservoir would be about \$20 per acre-foot. To this amount must be added the estimated transportation and distribution cost of about \$5 per acre-foot.

The supplemental seasonal water requirements for the South Fork Project service area would be about 6,000 acre-feet, which would require a 6,500 acre-foot

reservoir costing about \$1,400,000. The unit cost of water at the dam would be about \$12 per acre-foot. To this cost should be added the estimated transportation and distribution cost of about \$5 per acre-foot.

The Middle Fork Project would yield water costing approximately \$29 per acre-foot exclusive of distribution system costs. However, the project would probably have the highest recreation and stream flow enhancement benefits of those considered, and may merit further study in this connection.

The possibility of obtaining a supplemental water supply from Success Reservoir was evaluated. While the estimated cost of water from this source amounts to \$23 per acre-foot delivered at farm head gates and is comparable to the cost of water developed by the North and South Fork Projects, it has not been determined whether the Federal Government would allow storage of the water in the reservoir each year for agricultural purposes.

There is also the possibility of obtaining additional runoff by converting brushland to range land. While studies indicate an increase in water yield is possible under favorable conditions, there is insufficient information available for a definite quantitative evaluation.

The estimated cost of irrigation water developed by projects considered herein would range from about \$17 to \$34 per acre-foot delivered at farm head gates. This cost excludes the cost of exchange water for downstream users. Table 17 presents a comparison of costs and yields for development of supplemental water supplies for the upper Tule River Basin.

TABLE 17

COMPARISON OF POTENTIAL WATER DEVELOPMENT
PROJECTS FOR THE UPPER TULE RIVER BASIN

Project	Reservoir storage capacity, in acre-feet	Seasonal irrigation yield, in acre-feet	Capital cost, dam and appurte- nances	Annual costs			
				Dam and appurte- nances	Distri- bution system	Total	Per acre- foot of sea- sonal yield
North Fork	22,000	14,500	\$6,037,000	\$290,000	\$72,500	\$362,500	\$25
Middle Fork	1,400	2,200	1,146,000	64,000	11,000	75,000	34
South Fork	6,500	6,000	1,401,000	74,000	30,000	104,000	17

CHAPTER VI. CONCLUSIONS AND RECOMMENDATIONS

As a result of the reconnaissance field investigation and analysis of available data on the water resources and water problems of the upper Tule River Basin, and on the basis of estimates and assumptions discussed hereinbefore, the following conclusions and recommendations are made:

Conclusions

1. The present basic water problem in the upper Tule River Basin is the limitation on expansion of irrigated agriculture imposed by the scarcity of water remaining available for development in the Tule River.
2. The mean seasonal depth of precipitation over the upper Tule River Basin is about 31 inches, ranging from about 15 inches at the lower elevations to about 50 inches at the higher elevations. Mean seasonal unimpaired runoff of the Tule River above Porterville is about 140,000 acre-feet. Waters of the Tule River are generally of excellent mineral quality.
3. Present land use in the upper basin includes approximately 4,600 acres of irrigated land, 240 acres of urban land, and 270 acres used intensively for recreation.
4. Land classification surveys indicate that there are about 17,500 acres of irrigable lands in the upper basin. In addition, about 550 acres may be used for urban development, and as many as 9,400 acres may be used intensively for recreational purposes under conditions of ultimate development.

5. Water diverted from the upper Tule River in 1957 for consumptive purposes totaled about 23,600 acre-feet. About 98 percent of this diversion was for irrigation and incidental domestic use, and the remainder was used in urban and recreational areas.
6. Under ultimate conditions of development, the mean seasonal requirement for supplemental water in the upper basin is estimated to be about 35,000 acre-feet, of which about 92 percent would be for irrigation, 3 percent for urban use, and 5 percent for recreation.
7. As a result of prior appropriations and applications for appropriation downstream, no significant quantities of water appear to be now available for development from the Tule River, except in occasional wet years. However, water might be made available for development in the upper basin through exchanges with downstream users on the valley floor.
8. The principal source of import water which could be made available for exchange at the present time is the Friant-Kern Canal. Interim surplus water could possibly be obtained from this canal when available, which would be about half of the years, on the basis of the historical runoff record at Friant Dam. The new water supply, averaging 6,600 acre-feet per year, to be developed at Success Reservoir, apparently is too undependable to be of value for exchange, except in conjunction with other sources of exchange water.
9. In the future, probably in about 8 to 10 years, import water for exchange on the valley floor may be available on a firm basis from the San Joaquin Valley-Southern California Aqueduct of the State of California. This water will cost about \$14.00 per acre-foot, according to present estimates. In not less than 10 years,

import water may also be available from the East Side Division of the Central Valley Project of the U. S. Bureau of Reclamation.

10. Water sufficient to meet the ultimate supplemental water requirements for the assumed service area in the upper basin could be made available by storage on the North and South Forks of the Tule River, and the purchase of exchange water. The estimated capital cost of the North Fork Project would be \$6,037,000, and the seasonal irrigation yield, 14,500 acre-feet. Annual costs would be \$20 per acre-foot of yield for the dam and reservoir, and \$5 per acre-foot for distribution, or a total cost of \$25 per acre-foot of yield. The estimated capital cost of the South Fork Project would be \$1,400,000, and the seasonal irrigation yield, 6,000 acre-feet. Annual cost of the dam and reservoir would be \$12 per acre-foot of yield, and distribution costs would be \$5 per acre-foot, or a total cost of \$17 per acre-foot of yield. These values do not include the cost of the exchange water.
11. Repayment capacities for irrigation water are estimated as \$5 to \$8 per acre-foot of water used for irrigated pasture, and \$15 to \$30 per acre-foot for orchards and truck crops.
12. Storage on the South Fork of the Middle Fork of the Tule River would be valuable from the standpoint of recreation and stream flow enhancement.
13. Conversion of brush-covered watersheds to grass cover is a promising source of additional water, although not enough research has been done to enable quantitative estimates to be made now of the benefits resulting from treatment of large areas.

Recommendations

It is recommended that local interests in the upper Tule River Basin evaluate the range of water development costs presented herein with respect to their particular needs and ability to finance such development. If sufficient interest can be demonstrated in the development of supplemental water supplies for the upper basin, at the costs indicated, it is further recommended that supplemental studies be undertaken to define the most desirable projects, and to determine the engineering feasibility, economic justification, and financial feasibility thereof.

It is also recommended that further consideration be given to the conversion of brush-covered watersheds to grass cover as a means of increasing the available local water supply.

APPENDIX A

COOPERATIVE AGREEMENT BETWEEN THE
STATE OF CALIFORNIA, DEPARTMENT OF WATER
RESOURCES AND TULARE COUNTY

COOPERATIVE AGREEMENT
BETWEEN THE STATE OF CALIFORNIA,
DEPARTMENT OF WATER RESOURCES
AND TULARE COUNTY

This agreement, made and entered into as of the 30th day of June, 1958, by and between the State of California, acting by and through its Department of Water Resources, hereinafter referred to as the "State", and the County of Tulare, hereinafter referred to as the "County":

W I T N E S S E T H

WHEREAS, by Article 5, Chapter 1, Part 6, Division 6, of the Water Code of the State of California, the State is authorized to conduct investigations of the water resources of the State, formulate plans for the control, conservation, protection, and utilization of such water resources, including solutions for the water problems of each portion of the State as deemed expedient and economically feasible, and may render reports thereon; and

WHEREAS, by Article 4, Chapter 1, Part 6, Division 6, of the Water Code of the State of California, the State is authorized to cooperate with any county, city, state agency or public district on flood control and other water problems and when requested by any thereof may enter into a cooperative agreement to expend money on behalf of any thereof to accomplish the purposes of Chapters 1 and 2 of this part; and

WHEREAS, the County has requested the State to make a cooperative investigation and report on a study by the State to determine the amount of water, if any, available for development and use in the area above the proposed Success Reservoir;

NOW, THEREFORE, it is mutually agreed, subject to the availability of funds as follows:

(1) The State shall perform the work provided for by this agreement and shall prepare the report and otherwise advise and assist in formulating solutions to the water problems of the area.

(2) The work program shall be as set forth in the attached sheet, incorporated herein, entitled "Work Program" and marked "Exhibit A".

(3) The County shall contribute \$2,500 which shall be transmitted to the State prior to commencement of the work.

(4) The State shall contribute \$2,500 from funds appropriated to the Department of Water Resources by Item 257 of the Budget Act of 1958.

(5) Funds contributed by the parties shall be deposited in the Water Resources Revolving Fund in the State Treasury for expenditure by the State in performance of the work provided for in this agreement.

(6) The State shall under no circumstances be obligated to expend for or on account of the work provided for under this agreement any amount in excess of the funds made available hereunder.

(7) A statement of expenditures for each fiscal year beginning July 1 and ending June 30, shall be furnished the County by the State as soon as practicable after the close of the fiscal year.

(8) Upon completion and final payment for the work provided in this agreement, the State shall furnish to the County a statement of expenditures made under this agreement. Any unexpended balance of the \$5,000 referred to above shall be returned to the State and to the County in equal amounts.

(9) The work to be done under this agreement shall be diligently prosecuted with the objective of completing the report by June 30, 1959, or as nearly thereafter as possible.

IN WITNESS THEREOF, the parties hereto have executed this agreement.

Approved as to Form and
Procedure

COUNTY OF TULARE

/s/ RALPH B. JORDAN
Attorney, County of Tulare

By /s/ ROGERS L. MOORE
Chairman, Board of Supervisors

Approved as to Form and
Procedure

State of California
Department of Water Resources

/s/ MARK C. NOSLER
Chief Counsel, Department of
Water Resources

HARVEY O. BANKS
Director of Water Resources

Approved - Department of
Finance

By /s/ PAUL L. BARNES
Paul L. Barnes, Chief
Division of Administration

8/18/58

EXHIBIT A

Work Program

It is estimated that the investigation will be completed in one year. The work program would include the following:

1. Procure and organize personnel, prepare detailed work programs, compile available maps and other data, and review and become familiar with previous reports and studies throughout area.
2. Coordinate investigation with studies of water resources and requirements made under Chapter 61 of Statutes of 1956, and studies made by the State Water Rights Board. Supplement these studies as required.
3. Collect, compile, and analyze data on the water resources of the drainage basin.
4. Compile and review information on existing rights to water in both the drainage basin and the area of use on the San Joaquin Valley floor.
5. Determine the present use of water in the drainage basin and estimate the probable ultimate requirements.
6. Determine in a preliminary manner the amount of remaining unappropriated water, if any, available for the upper watershed.
7. Determine practicability of obtaining additional water for the upstream area by effecting an exchange with present users of Tule River water on the valley floor.
8. Prepare a report on the investigation and include recommendations for further action based upon the quantity of water found to be available for development.

APPENDIX B

APPLICATIONS TO APPROPRIATE WATER FROM THE TULE RIVER

This appendix contains data on applications to appropriate water from the Tule River, filed with the State Water Rights Board prior to July 10, 1959.

The applications to appropriate water have been assigned diversion numbers by the Department of Water Resources, which are referred to the townships, range and section subdivisions of the Public Land Survey.

Under the system, each section is divided into 40-acre tracts, lettered as follows:

D	C	B	A
E	F	G	H
M	L	K	J
N	P	Q	R

Diversions are numbered within each 40-acre tract according to the sequence in which they have been assigned numbers by the department. For example, a diversion having a number 20S/30E-26D1 is found in Township 20 South, Range 30 East, and in Section 26. It is further identified as the first diversion located in the 40-acre plot lettered D. All the diversions in the Tule River area are referenced to the Mt. Diablo Base and Meridian.

TABLE R-1

**APPLICATIONS TO APPROPRIATE WATER
FROM THE TULE RIVER UPSTREAM FROM SUCCESS DAM**
(Filed with the State Water Rights Board as of July 10, 1959)

Application number	Date filed	Present owner	DWR diversion number	Source	Location of point of diversion					Amount	Period of diversion	Purpose	Status
					V_4	V_4	Sec	Tr	R	B & M			
1-49	9/22/29	Pacific Gas and Electric Co.	203/312-321	Summit Meadow Creek Springs	SE	16	13	42S	35E	10	Jun 1-Dec 31	Power	1-449
324	2/6/23	Geo. H. and H. E. Lawson	192/305-312	Spring tributary to Shepherd's Creek tributary to Bear Creek	NW	52	33	11S	31W	10	Jun 1-Dec 31	Domestic and irrigation, 3 acres	1-1018
434	3/24	D. C. Lindsey et al.	—	Nelson Creek	SE	42	48	22S	31E	10	Apr 1-May 1	Domestic and irrigation, 1 acre	1-570
457	3/19/25	Camp Nelson Water Co.	—	Nelson Creek	SE	28	24S	31E	10	10	Apr 1-May 1	Domestic	1-1384
541	6/20/27	Soda Flat Water Association	—	Spring tributary to Railroad Creek	SW	51	34	20E	31E	10	Jun 1-Sept 15	Domestic	1-1972
516	6/25/27	Linder Hardware Co.	—	Nelson Creek	SE	28	22E	31E	10	10	Apr 1-May 1	Domestic	1-485
680	1/25/31	Henry Stahlhoff, et al.	203/312-321	Bear Creek	SE	47	3	22E	34E	10	Mar 15-Oct 15	Irrigation, 74 acres	1-1170
692	6/26/31	Fred and Barbara Balesand	—	Spring tributary to South Fork of Middle Fork of Tule River	SE	34	35	22E	31E	10	May 15-Sept 15	Domestic	1-1139
719	11/2/31	United States Sequoia National Forest	—	Spring tributary to Railroad Creek	NE	34	23S	31E	10	10	May 1-May 1	Domestic	1-1668
8137	10/15/34	United States Sequoia National Forest	—	Nelson Park (South Fork) of Middle Fork of Tule River	NW	51	35	22S	31E	10	Apr 1-May 1	Domestic and fire protection	1-2136
857	1/22/36	United States Sequoia National Forest	—	Nelson Park (South Fork) of Middle Fork of Tule River	SW	34	35	22S	31E	10	May 1-May 1	Domestic and fire protection	1-2356
9402	8/26/38	George J. Whipple and Milton Miller	—	Tributary to North Fork of Tule River	NE	34	7	14E	31E	10	Jun 1-Dec 31	Domestic and irrigation, 0.81 acres	1-2404
9415	9/27/38	United States Sequoia National Forest	—	South Fork of Middle Fork of Tule River	SW	34	35	22S	31E	10	May 1-May 1	Domestic and fire protection	1-2327
9416	9/27/38	United States Sequoia National Forest	—	McIntyre Creek	NW	34	35	22S	31E	10	May 15-Nov 1	Domestic and fire protection	1-2505
9417	9/27/38	United States Sequoia National Forest	—	South Fork of Middle Fork of Tule River	SW	34	34	22S	31E	10	Apr 1-Dec 31	Forest, domestic and fire protection	1-2328
9817	1/21/40	Ferry Martin	—	Spring tributary to Bear Creek	SW	32	19S	30E	30E	10	Jun 1-Dec 31	Domestic	1-2371
9931	6/21/40	William F. Ambler	203/295-301	Long Canyon Creek	NW	34	32	22S	30E	10	May 1-May 1	Irrigation, 43 acres	1-2828
9861	7/31/40	John Edward Rice	203/305-311	Tributary to Bear Creek	SE	34	19S	30E	30E	10	May 1-Sept 15	Domestic and irrigation, 12 acres	1-2413
10370	1/21/42	United States Sequoia National Forest	—	Spring tributary to South Fork of Middle Fork of Tule River	NE	8	21S	34E	34E	10	Jun 1-Oct 15	Domestic and recreational	1-1193
10940	1/21/45	Tule Lake Basin Water Storage District	—	Tule River	NW	35	21S	22E	22E	10	Jun 1-Dec 31	Domestic, flood control and irrigation, 16,400 acres	Pending
11362	4/8/46	W. H. and Lester M. Smith	—	Minor Creek	NE	34	21S	31E	31E	10	May 1-Oct 31	Domestic and fire protection	1-4819
11904	5/27/47	Oscar Slope Mutual Water Co.	—	Marshall Creek	SE	26	22S	31E	31E	10	Jun 1-Dec 31	Domestic	1-6941
11772	7/21/47	United States Sequoia National Forest	—	Spring tributary to South Fork of Middle Fork of Tule River	NE	8	21S	34E	34E	10	Jun 1-Oct 31	Domestic and stockwatering	1-1350
1555	7/26/48	John Edward Rice	203/305-321	Tributary to Bear Creek	NE	3	22S	30E	30E	10	Mar 1-Apr 30	Irrigation, 13 acres	1-4647

P - Indicates permit number of application approved.

I - Indicates license number of right confirmed.

Incomplete - Indicates application not yet complete.

Pending - Indicates application complete but not yet approved.

**APPLICATIONS TO APPROPRIATE WATER
FROM THE TULE RIVER UPSTREAM FROM SUCCESS DAM**
(Filed with the State Water Rights Board as of July 10, 1959)

Application number	Date filed	Present owner	DWR diversion number	Source	Location of point of diversion						Amount	Period of diversion	Purpose	Status
					1/4	1/4	Sec	TP	R	B				
13445	11/4/49	United States Semoda National Forest	—	Bear Creek	NE	SE	3	21.5	31E	ND	0.0127 cfs	Apr 1-Mar 30	Domestic	P-8024
13499	12/5/49	John Edward Bace	235/93E-3E1	Spring tributary to Bear Creek	NW	SW	3	20.5	30E	ND	0.08 cfs	May 1-Sept 15	Irrigation, 15 acres	L-3798
14181	3/8/51	United States Semoda National Forest	—	Kramer Spring	NE	NE	13	19.5	29E	ND	530 gpd	May 1-Oct 15	Stockwatering	L-4120
14241	4/9/51	John H. and Laura H. Dilts	—	Spring tributary to Kramer Creek	NE	NE	13	19.5	29E	ND	7,200 gpd	May 1-Sept 15	Domestic, stockwatering and irrigation, 3 acres	L-4166
14593	3/3/52	John Edward Bace	235/93E-3E1	Spring tributary to Bear Creek	SE	NE	4	20.5	30E	ND	0.02 cfs	May 1-Sept 15	Irrigation, 15 acres	L-4449
14793	5/5/52	John H. and Laura H. Dilts	—	Spring tributary to Kramer Creek	SE	SE	12	19.5	29E	ND	15,640 gpd	May 1-Sept 15	Stockwatering and irrigation, 3 acres	L-4167
14860	6/16/52	Department of Water Resources	—	Tule River	—	NE	35	21.5	28E	ND	2,350 cfs 175,000 af	Jan 1-Mar 31 Oct 1-Mar 1	Domestic, stockwatering, mining, recreational, industrial and irrigation, 647,000 acres	Incomplete
14876	6/25/52	United States Semoda National Forest	—	Tributary to South Fork of Middle Fork of Tule River	NE	SW	8	21.5	32E	ND	275 gpd	May 1-Mar 30	Domestic, recreational and stockwatering	L-4152
15065	10/27/52	John H. and Laura H. Dilts	—	Spring No. 1 tributary to Kramer Creek	SW	NW	7	19.5	30E	ND	7,200 gpd 2,680 gpd	Jan 1-Mar 31	Domestic, stockwatering and irrigation, 3 acres	P-9214
15289	4/23/53	Bryan and Mildred Jones	186/93E-3471	Rocky Cliff Creek	SW	SW	34	19.5	29E	ND	45 af	Nov 15-Mar 1	Stockwatering and irrigation, 10 acres	L-4745
15931	6/25/54	Mrs. Gladis Gill	—	Hickman Creek	NE	SW	15	20.5	29E	ND	750 af	Dec 1-Mar 31	Irrigation, 402 acres	Pending
16036	9/8/54	John H. and Laura H. Dilts	—	Spring tributary to Kramer Creek	SE	SE	12	19.5	29E	ND	4,320 gpd	May 1-Sept 15	Domestic, stockwatering and irrigation, 8 acres	P-10249
16024	4/23/55	R. B. Killian	235/93E-1001 235/93E-1001	Two tributaries to Bear Creek	SE	NE	10	20.5	29E	ND	30 af	Oct 1-May 31	Domestic, stockwatering and irrigation, 20 acres	Pending
16443	10/6/55	W. A. Witt	215/93E-1592	Tributary to Blue Creek	SW	SW	15	21.5	29E	ND	0.6 cfs 30 af	Mar 1-Oct 31 Mar 1-Oct 31	Irrigation, 2 acres	Pending
16460	10/20/55	John H. and Laura H. Dilts	—	Spring tributary to North Fork of Tule River	NW	SW	24	19.5	29E	ND	11 af	Jan 1-Mar 31	Stockwatering	Pending
				Spring tributary to North Fork of Tule River	SW	SW	13	19.5	29E	ND	9 af	Jan 1-Mar 31	Stockwatering	Pending
				Spring tributary to North Fork of Tule River	NW	NW	13	19.5	29E	ND	2.5 af	Jan 1-Mar 31	Stockwatering	Pending
				Tributary to North Fork of Tule River	NW	SE	13	19.5	29E	ND	1.3 af	Jan 1-Mar 31	Stockwatering	Pending
				Tributary to North Fork of Tule River	SE	SE	13	19.5	29E	ND	2.4 af	Jan 1-Mar 31	Stockwatering	Pending
16472	10/7/55	A. O. Griswold	—	Tributary to North Fork of Tule River	NW	NW	36	19.5	29E	ND	3.7 af	Nov 1-Apr 15	Stockwatering and irrigation, 9 acres	Pending
				Tributary to North Fork of Tule River	NW	NW	36	19.5	29E	ND	1.0 af	Nov 1-Apr 15	Stockwatering and irrigation, 20 acres	Pending
16490	10/21/55	Merry C. Seitz	—	Tributary to North Fork of Tule River	NW	NW	25	19.5	29E	ND	9 af	Nov 1-Apr 15	Stockwatering and irrigation, 20 acres	Pending
				Tributary to North Fork of Tule River	NW	SE	25	19.5	29E	ND	9.7 af	Nov 1-Apr 15	Stockwatering and irrigation, 20 acres	Pending
				Tributary to North Fork of Tule River	SE	NE	23	19.5	29E	ND	1.3 af	Nov 1-Apr 15	Stockwatering and irrigation, 20 acres	Pending
16496	10/26/55	Norman L. and Cora M. Morris	235/93E-301	Drain tributary to North Fork of Tule River	NE	NW	3	20.5	29E	ND	47 af	Oct 1-Jun 15	Stockwatering and irrigation, 20 acres	Pending
16705	10/31/55	Bryan Jones	—	Tributary to North Fork of Tule River	SW	SW	33	19.5	29E	ND	16 af	Nov 1-Apr 15	Irrigation, 34 acres	Pending
16717	11/2/55	Hardy McGee	—	Campbell Creek	NW	NE	17	21.5	29E	ND	9 af	Nov 15-Apr 15	Irrigation, 15 acres	Pending
16718	11/4/55	W. L. Bailey	—	Marshall Creek	SE	SE	26	20.5	31E	ND	1,610 gpd	Apr 1-Mar 30	Domestic	Pending
16748	11/28/55	John F. Pass	—	Tributary to Graham Creek	SW	SW	30	21.5	30E	ND	1 af	Nov 15-Apr 15	Stockwatering	Pending

P - Indicates permit number of application approved.
I - Indicates license number of right confirmed.
Incomplete - Indicates application not yet complete.
Pending - Indicates application on file but not yet approved.

P - Indicates permit number of application approved.

I - Indicates license number of right confirmed.

Incomplete - Indicates application not yet complete.

Pending - Indicates application complete but not yet approved.

TABLE B-1 (Continued)

**APPLICATIONS TO APPROPRIATE WATER
FROM THE TULE RIVER UPSTREAM FROM SUCCESS DAM**
(Filed with the State Water Rights Board as of July 10, 1959)

Application number	Date filed	Present owner	DWR diversion number	Source	Location of point of diversion						Amount	Period of diversion	Purpose	Status*
					V ₄	V ₄	Sec	Tp	R	S B M				
16810**	12/27/55	South Tule Independent Ditch Co.	(see)	South Fork Tule River	NE	NE	15	22S	29E	MD	1,400 af	Nov 1-Apr 30	Irrigation, 800 acres	Pending
16817	1/3/56	Hugh T. Gordon	233/29S-41L	Tributary to Campbell Creek	NE	SW	4	21S	29E	MD	47.5 af	Nov 15-Apr 15	Irrigation, 43.4 acres	Pending
16824	1/21/56	John M. and Laura H. Dikins	—	Tributary to Keweenaw Creek	SW	SW	12	19S	29E	MD	1 af	Jan 1-Dec 31	Stockwatering	Pending
				Tributary to Buckhorn Creek	SW	SW	18	19S	29E	MD	2 af	Jan 1-Dec 31		
				Tributary to Keweenaw Creek	SE	SE	13	19S	29E	MD	0 af	Jan 1-Dec 31		
16860	1/27/56	Ray E. Cole	—	Tributary to North Fork of Tule River (upstream from Cole's diversion 19S/29E-200L)	NE	NW	26	19S	29E	MD	16 af	Dec 1-Apr 1	Irrigation, 22 acres	Pending
16892	2/21/56	Richard and M. D. Freeborn	—	Marshall Creek	SE	SE	26	20S	31E	MD	18.0 gpd	Apr 1-Nov 30	Domestic	Pending
17107	5/28/56	Bryan Jones	—	Tributary to Hickman Creek	NW	NE	8	20S	29E	MD	3 af	Nov 1-Apr 15	Stockwatering	Pending
17597	3/21/57	Aune O'Connor	—	Tributary to North Fork of Tule River	SE	NW	4	20S	29E	MD	4 af	Nov 1-Apr 15	Domestic and stockwatering	Pending
17552	3/28/57	M. R. Kincaid	—	Tributary to Tule River	SW	SW	15	21S	28E	MD	5 af	Nov 1-Apr 15	Domestic and stockwatering	Pending
				Tributary to Tule River	SE	SE	22	21S	28E	MD	14 af	Nov 1-Apr 15		
18326	9/22/58	Clayton H. and J. C. Harts	—	Spring and stream tributary to North Fork of Tule River	SW	SW	19	19S	29E	MD	9 af	Nov 1-Apr 30	Recreational and Irrigation, 30 acres	Pending
18615	3/21/59	V. H. and R. B. McGinnis	233/29S-20L 233/29E-30L	Tributary to North Fork Tule River	NW	SW	2	20S	29E	MD	20 af	Nov 1-Dec 31	Irrigation	Pending
				Tributary to North Fork Tule River	SW	SE	2	20S	29E	MD	17 af			

* P. - Indicates permit number of application approved.

** This application is for right to store water at location of present South Tule Ditch diversion 233/29E-52L.

Incomplete - Indicates application not yet complete.

Pending - Indicates application complete but not yet approved.

(Filed with the State Water Rights Board on July 10, 1959)

Application Number	Date Filed	Present Owner	DWR Diversion Number	Source	Location of Point of Diversion						Amount	Period of Diversion	Purpose	Status
					1/4	1/4	Sec.	Tp.	R.	B. & M.				
355	5/24/16	Tulare Lake Basin W.S.D.		Tulare River	NE	NE	1	22S	21E	MD	150,000 ac	1/1-7/15	Irrigation and Domestic	Pending
505	10/27/16	Ralph J. Gilkey		Cross Creek and Tulare Lake	SE	EW	18	21S	22E	MD	6cfs	1/1-11/1	Irrigation	License
3179	12/15/22	South Lake Farms, et al.		Tulare Lake	NE	NE	1	22S	20E	MD	200cfs	7/1-12/31	Irrigation	Pending
3150	12/15/22	South Lake Farms, et al.		Tulare Lake	NE	NE	1	22S	20E	MD	100cfs	7/1-12/31	Irrigation	Pending
3151	12/15/22	South Lake Farms, et al.		Tulare Lake	NE	NE	1	22S	21E	MD	100cfs	7/1-12/31	Irrigation	Pending
17942	1/ 2/15	Tulare Lake Basin W.S.D.		Tulare River			1	22S	22E	MD	2,000cfs	1/1-12/31	Irrigation, Domestic and Flood Control	Pending
					SE	SE	26	22S	22E	MD				
					SE	SE	35	21S	20E	MD	50,000 ac	1/1-12/31		
11860	6/16/52	State Department of Water Resources		Tulare River			35	21S	20E	MD	2,500cfs	1/1-12/31	Irrigation, Domestic and Flood Control	Incomplete
15231	3/ 9/53	Tulare Lake Basin W.S.D.		Tulare Lake	at various points around the margin of the pump reservoir						75,000 ac	10/1-7/1	Irrigation, Domestic and Flood Control	Pending
15594	11/ 2/53	Crockett and Garborg, Inc.		Tulare River	SU	SE	33	21S	23E	MD	1,000,000 ac	1/1-12/31	Irrigation, Domestic and Stockwater	Pending
18652	7/10/59	Andy and Lilly Wheat		Tulare River	NE	SE	6	22S	23E	MD	20cfs		Irrigation	Incomplete
					NE	SW	6	22S	23E	MD				
18653	7/10/59	Hayne and Virginia Murray		Tulare River	NE	NE	5	22S	23E	MD	22.5cfs		Irrigation	Incomplete
					NE	SW	5	22S	23E	MD				
					NW	SW	6	22S	23E	MD				

Pending - Indicates application complete but not yet approved.

APPENDIX C

SURFACE WATER DIVERSIONS IN THE UPPER TULE RIVER BASIN

This appendix contains information pertinent to water diverted from the Tule River above Success Dam during the period April 1957 to March 1958. The diversions are numbered according to the system described on page B-1.

The upper Tule River Basin was subdivided into six subunits to help the reader locate the diversions. Brief descriptions of the subunits follow:

Middle Fork. The watershed of the Middle Fork of the Tule River above the confluence of the North and South Forks of the Middle Fork.

Springville. The watershed along a 9-mile reach of the Tule River and the Middle Fork from a point about 1 mile south of Springville to the confluence of the North and South Forks of the Middle Fork. Also included is the watershed of the North Fork from its mouth to Bear Creek.

North Fork. The watersheds of the North Fork and Bear Creek above the confluence of the two streams.

Success. The watershed of the Tule River, excluding the South Fork, from Success Dam to a point about 1 mile south of Springville.

Reservation. The watershed of the South Fork of the Tule River above the western boundary of the Indian Reservation.

South Fork. The watershed of the South Fork from its mouth to the Indian Reservation.

**SURFACE WATER DIVERSIONS
IN THE UPPER TULE RIVER BASIN
April 1957 - March 1956**

DNR Location number	Diversion name and/or owner	Source	Water use April 1957 - March 1958			Apparent water right			Indicated date of appropriation or first use	Description of diversion system	Remarks
			Purpose	Extent and method of use	Amount diverted in acre-feet	Type	Amount	Reference			
Springville Subunit (Continued)											
215/296-320 H. B. & J.	Long Canyon Ditch W. F. Hummel	Long Canyon Creek	Irrigation	11 acres by flooding and furrow	38	Appropriative	0.5 cfs	A-991b	1940	Gravity; concrete and masonry dam 8 feet high, 24 feet long, with 0.4 mile of earth ditch.	Area irrigated received supplemental supply from 203/292-322.
215/296-321	Mr. Johnny Bitch; Mr. Wilney Bitch and sister County	Middle Fork Tule River	Irrigation	221 acres by flooding, 2 furrow, and sprinkler Home gardens in Springville	1,465	Adjudicated Adjudicated Adjudicated	3.38 cfs 4.0 cfs 4.0 cfs	Par. VII d Par. 29c Par. 5c	About 1880	Gravity; rock and sheet-metal dam 2 feet high, 20 feet long, with 0.4 mile of earth ditch and pipeline.	Former owners: John A. Rabus, Frank Conley, Andrew J. Doby, and others. Diversion by diversion through Springville Pipe, Division 215/292-622.
215/296-322	Walker Ditch A. J. Skillion	Tule River	Irrigation Stockwatering	17 acres by flooding 15 head	227	Adjudicated Adjudicated	26.67 cfs 0.67 cfs	(*) (*)	1871	Gravity; concrete dam about 6 feet high, with 0.4 mile of earth ditch. Dam also used for 215/292-322.	Also referred to as Tully Ditch. Former owner: Walker, A. M. Cohn, local owner: Henry Bitch, Frank Talley, and others. Diversion by diversion through Springville Pipe, water right amounts reported are 2/3 of those adjudicated to the Walker Ditch by Par. 19c, Case No. 18318, and Par. 5, Case No. 18318, respectively.
215/296-323	Frank K. Kibler	Tule River	Irrigation Stockwatering	10 acres by sprinkler —	25	Adjudicated	20 MI	Par. 19c	Prior 1916	Gravity; concrete dam about 6 feet high, with 0.4 mile of earth ditch and pump. Dam also used for 215/292-321.	Former owners: C. A. Davidson, S. L. Campbell, Case No. 17024, decreed 5.0 cfs for power of which 20 MI could be used for irrigation. Power right not now exercised.
215/296-324	Graham-Osbom Ditch	Tule River	Irrigation	683 acres by flooding, furrow, and Fishing ponds	2,528*	Adjudicated Adjudicated Adjudicated	1.32 cfs 10.0 cfs 6.0 cfs	Par. VII d Par. XII d Par. 29c Par. 6*	1871	Gravity; rock dam with 8.0 miles of earth ditch and pipeline.	Amount diverted used to irrigate 66 acres jointly with 215/292-321 (see case No. 18318). In addition to the reported area irrigated.
215/296-325	Pleasant Valley Ditch; Pleasant Valley Canal Co.	Tule River	Irrigation Stockwatering	714 acres by flooding, furrow, and sprinkler	2,755*	Adjudicated Adjudicated Adjudicated	13.64 cfs 10.0 cfs 6.0 cfs	Par. VII d Par. XII d Par. 1, 2c	About 1870	Gravity; concrete dam 3 feet high, 25 feet long, with 8.0 miles of earth ditch.	Reported amount diverted includes water for the Valley River right owned by Hugh T. Gordon.
215/296-326	Walker M. Hahn and Claude A. Bouch	Tule River	Irrigation Stockwatering Recreation	47 acres by furrow and sprinkler Fishing in reservoir	93*	Adjudicated Riparian	(*) (*)	Par. 6*	Prior 1870	Gravity; pump and storage; small dam and 0.1 mile of earth ditch to 1 1/2 hp electric-powered pump and alternate waterwheel-driven pump with 0.3 mile of 6-inch pipe and 10-acre-foot reservoir.	Former owners: Clyde Baker, A. V. Wood, and others. Diversion is that by electric-powered pump only. Waterwheel pump is used for the ditch flow required for its operation. Predecessor was mentioned in Case No. 18318 as being entitled to a reasonable riparian use but no diversion settle- ment was specified.
215/296-327	Duncan Ditch Senola's Stock Farm	Tailrace of Tule Powerhouse (S2)	Irrigation Stockwatering	120 acres by flooding —	760*	Adjudicated	90 MI	Par. 31c	About 1860	Gravity; short 12-inch steel pipe and 2-inch steel pipe from Tule Powerhouse to the city of Springville. Tailrace, and 1.1 miles of earth ditch.	Former owner: Harry E. Stables, Charles A. Batters, and others. Diversion from Tule River. Reported amount diverted is total for period July 1937 - March 1938 only.
215/296-328	Springville Pipe Tulare County	Tailrace of Tule Powerhouse (S2)	Municipal	About 1,250 persons flooding 110 head	322*	Adjudicated	—	—	1924	Gravity; 2" cut of 16-inch and 1.0 mile of 12-inch pipe from Tule Powerhouse tailrace to water treating plant.	Of the amount diverted, 90 acre-feet was used by Tulare and Kings Counties for the city of Springville. Diversion by Springville Public Utility District.
North Fork Subunit											
195/296-230	Flag-Gold Ditch W. A. McCallum	Franker Creek	Irrigation Stockwatering	18 acres by furrow and flooding 110 head	72*	Riparian	—	—	About 1860	Gravity; rock dam 1 foot high diverts to ditch from 195/292-244.	Former owners: James Flagg, Frank Flagg, P. Flagg, Robert, Walter Stratt, Shoemaker, and others. Diversion Reported amount diverted includes all water diverted by 195/292-244. Combined supply used for the purposes indicated.

* - See remarks.

For lettered footnotes, see last page of table.

**SURFACE WATER DIVERSIONS
IN THE UPPER TULE RIVER BASIN
April 1957 - March 1958**

DNR location number	Diversion name and/or owner	Source	Water use April 1957 - March 1958			Apparent water right			Indicated appropriation or first use	Description of diversion system	Remarks
			Purpose	Extent and method of use	Amount diverted in acre-feet	Type	Amount	Reference			
North Fork Subunit (Continued)											
N.D.B. & H.											
195/305-100	Dillon Ditch Harry G. Scruggs	North Fork Tule River	(*)	(*)	None	Adjusted	100 HC	Par. 7 ^c	About 1880	Gravity; rock dam with 110 feet of wood flume to 1.7 miles of natural channel and earth ditch.	Former owners: George Dillon, Alford Mathews. Diversion structure washed out in December 1955 and not replaced until 1956. Normally used in spring and summer. Diversion used in conjunction with 198/292-201.
195/305-101	G. B. Stacey	Spring tributary to North Fork Tule River	Irrigation Stockwatering	5 acres by sprinkler 12 head	Not meas.	(n)	—	—	About 1900	Gravity; small concrete diversion structure with 0.5 mile of 8- and 10-inch pipe.	Former owners: Billy Phillips, Bear.
195/305-201	Albert Hallin	Amorbia Creek	Irrigation	14 acres by flooding and sprinkler	89	Adjustment	—	—	1889	Gravity; rock dam with 0.3 mile of earth ditch to 22-acre- foot reservoir and 0.3 mile of 8- and 8-inch pipe.	Former owners: William Berry, Ozell Vernon.
195/305-301	Otis R. and R. E. Lundon	Spring tributary to Amorbia Creek	Irrigation Stockwatering Domestic	4 acres by furrow 125 head (p)	Not meas.	Appropriative	0.015 cfs	A-324b	1923	Gravity; 0.3 mile of 3- and 2- inch pipe.	Former owner: John L. Lawson.
205/292-201	James Eversing*	North Fork Tule River	(*)	(*)	None	Adjusted	2.0 cfs ^a , 2.0 cfs ^b	Par. VIII ^c Par. 21 ^c	Prior 1910	Pump; 100 feet of 6-inch pipe and 0.1 mile of earth ditch.	Ownership changed from James Eversing to former owners: Earl Swain, Bob Taylor, Frank Shively, G. A. Richardson, M. P. Palmer. Amount of water right is 100 acre-feet. Diversion used by Richardson and Bob Creek Ditches, now exercised by this diversion. Previously irrigated 18 acres by flooding and watered 150 livestock.
205/292-201	James Eversing*	North Fork Tule River	Irrigation Stockwatering	94 acres by flooding and sprinkler 300 head	263	Adjusted	3.0 cfs ^a , 3.0 cfs ^b	Par. XIII ^c Par. 19 ^c	1864	Gravity; rock dam with 1.9 miles of earth ditch.	Former owners: Cromwell Alex. J. K. Bremer, Lillie J. S. Bailey.
205/292-201	James Eversing*	Tributary to North Fork Tule River	(*)	(*)	(*)	Appropriative	20 af	A-1805 ^b	1949	Earth dam, 20 acre-foot reservoir with 1,500 feet of earth ditch to reservoir of 205/292-201.	Ownership changed to Valner M. McDaniels, June 1958. Application 18615 filed by McDaniels for appropriation of 80 acres. Not used in 1957.
205/292-201	James Eversing*	Tributary to North Fork Tule River	(*)	(*)	(*)	Appropriative	17 af	A-1805 ^b	Prior 1952	Earth dam, 17 acre-foot reservoir.	Ownership changed to Valner M. McDaniels June 1958. Application 18615 filed by McDaniels for appropriation of 80 acres. Not used in 1957.
205/292-301	Norman L. and Cora L. Morris	Tributary to North Fork Tule River	(*)	No record*	—	Appropriative	47 af	A-1698 ^b	1955	Earth dam, 47 acre-foot reservoir with pipeline to sprinkler.	Application 16986 filed for irrigation of 20 acres and for stockwatering.
205/292-100	Roland K. Killian	Tributary to North Fork Tule River	(*)	(*)	(*)	Appropriative	30 af	A-1620 ^b	1955	Earth dam, 30 acre-foot reservoir.	Application 16204 for 205/292-100 was filed for irrigation of 20 acres and for stockwatering. Not used in 1957.
205/292-101	Roland K. Killian	Tributary to North Fork Tule River	(*)	No record*	(*)	(*)	(*)	(*)	1955	Earth dam and conduit to reservoir of 205/292-100.	Combined with 205/292-100 in Application 16204.
205/292-110	Pharis Ditch Earl D. Kuyon	North Fork Tule River	Irrigation Stockwatering	94 acres by flooding* 250 head	698	Adjusted	170 HC ^a	Par. 6, 20 ^c	About 1860	Gravity; rock dam and sanding dam with 0.7 mile of earth ditch.	Former owners: Pharis, John McKelmar, J. E. Bremer, E. D. Kuyon, N. A. Gilbert. Diversion structure was damaged by flood in 1956. Water supply from ground water. Apparent water right claim includes 50 acres of water right and 100 acres of water right. Case No. 7000. Par. 20, Case No. 7000.
205/292-130	Ed Jones	Bear Creek	Irrigation Stockwatering	7 acres by flooding —	78	Adjustment	—	—	1874	Gravity; wood dam with 0.3 mile of earth ditch.	Former owners: Gus Wilkhouse, Sherman, N. Gilbert, Ned Green.
205/292-132	Ed Jones	Bear Creek	Irrigation Stockwatering	12 acres by flooding —	76	Adjustment	—	—	1874	Gravity; rock dam and sanding dam with 0.5 mile of earth ditch, flume and pipe.	Former owners: Gus Wilkhouse, Sherman, N. Gilbert, Ned Green.

* - See remarks.

For lettered footnotes, see last page of table.

IN THE UPPER TULE RIVER BASIN

April 1957 - March 1958

D.R. Location number	Diversion name and/or owner	Source	Water use April 1957 - March 1958			Apparent water right			Indicated date of approximation or first use	Description of diversion system	Remarks
			Purpose	Extent and method of use	Amount diverted in acre-feet	Type	Amount	Reference			
215/295-101	Walter A. Pitt	Trinchley to Tule River	(*)	(*)	(*)	Appropriative	0.6 cfs 30 af	4-16-64 p	1955	Earth dam, 30 acre-foot reservoir.	Reservoir also receives water from Grubbs-Dubbin Ditch (215/295-141) and Grubbs-Dubbin Ditch (215/295-141). Reservoir stocked with fish. Irrigated 42 acres. Not used in 1957.
215/295-102	Mount Ditch William J. Aron Griffin Cogarty Norman D. Roberts	Tule River	Irrigation Stockwatering	117 acres by flooding and sprinkler	1,013	Adjudicated	6.0 cfs	Par. VII d	1869	Gravity; concrete dam about 2 feet high, 25 feet long, with 2.5 miles of earth ditch.	Former owners: George H. B. Vincent, Sena Wallace, E. F. Wallace, Frank Bentley, Badger, C. M. Stubbins, Tommy Stubbins, and the late Irrigated by this diversion are within the high-water line of Success Reservoir now under construction.
215/295-103	One Ditch Arthur Wardlaw	Tule River	Irrigation Stockwatering	101 acres by flooding	2,360	Adjudicated	5.5 cfs	Par. 3c	1873	Gravity; concrete dam with 1.5 miles of earth ditch.	Former owners: Rose, John Moore, Markberry, Anna B. Wardlaw, James Wardlaw. Portion of the lands Irrigated by this diversion are within the high-water line of Success Reservoir now under construction.
215/295-104	Snake Ditch Doris Krashe Arthur Wardlaw	Tule River	Irrigation Stockwatering	23 acres by flooding	966	Adjudicated	(b)	Par. 4c	1871	Gravity; polyethylene-covered rubble dam with 0.4 mile of earth ditch.	Former owners: Forde, M. H. Traylor, Anna B. Wardlaw, James B. Wardlaw, lands irrigated by this diversion are within the high-water line of Success Reservoir now under construction.
215/295-201	J. J. Rangel	Grubbs Creek	Stockwatering Recreation	Fishing in reservoir	30	(n)	--	--	1947	Gravity and storage dam with 0.5 mile of earth ditch to 45-acre-foot reservoir.	
Reservoir Subunit											
225/295-101	Agency Ditch Tule River Indian Reservation	South Fork Tule River	Domestic Irrigation	Scattered small pastures	Not meas.	Riparian			1890	Gravity; rubble masonry dam 4 feet high, 40 feet long, with 0.8 mile concrete-lined ditch.	Amount diverted, details of use and water right data reported under 225/295-101 (South Fork Subunit).
225/295-102	South Fork Ditch; Independent Ditch Company	South Fork Tule River	Irrigation Stockwatering	(*)	(*)	(*)	(*)	(*)	1896	Gravity; concrete dam 3 feet high, 25 feet long, with 0.8 mile of 12-inch pipe to junction with ditch from 225/295-152 (South Fork Subunit).	
225/295-103	Union Ditch Tule River Indian Reservation	South Fork Tule River	Domestic Irrigation	None	None	Riparian			1890	Gravity; rubble masonry dam 3 feet high, 30 feet long, with 2.0 miles of flume, with 0.8 mile concrete-lined pipe, concrete-lined and earth ditch.	
225/295-104	Tripp's Ditch Tule River Indian Reservation	South Fork Tule River	Domestic Irrigation	Scattered small pastures	Not meas.	Riparian			1919	Gravity; 2.2 miles pipe and concrete-lined ditch.	

* = See previous page.

For letters of address, see last page of table.

APPENDIX D

COMMENTS OF TULARE COUNTY, PREPARED BY TULARE COUNTY WATER COMMISSION

February 6, 1961

We have just had the opportunity to review the above mentioned report and want to compliment Harvey O. Banks and his Staff for a very complete and factual review of the conditions existing on the Tule River and the conclusions reached on supplying the areas above Success Dam with necessary irrigation water on an exchange basis.

We have the following comments and suggestions:

1. The description of Success Reservoir on Pages 25 and 26 should contain the following: That the proposed criteria of operation by the Corps of Engineers for Flood Control purposes and conservation benefits requires that the Dam be emptied of all conservation water by October 1st of each year and no conservation storage permitted until February 1st of the following year. This means that there is no carryover storage from one year to another and the 6,600 acre feet of new water is only an average and there are many years that none of this water would be available.

2. The discussion of the supplemental water requirements on pages 28 and 29 indicate approximately 28% return flow to the stream from applied irrigation water. It is doubtful that during the maximum consumptive use months of the crops this return water would occur in such quantity for use by downstream users. However, for the purpose of this report a qualifying statement calling attention to this matter and that further study should be given when any final report is made for the acquiring of a supplemental water supply would be sufficient.

*3. The total runoff shown for Turnbull Station in 1944-45 (Table 13, Page 32) should read 54,400 acre-feet rather than the 59,400 acre-feet shown. In commenting on the water passing Turnbull Gaging Station on the Tule River this not only includes the runoff from Elk Bayou, which is part of the Kaweah River system, but also includes additional water through Deep and Cameron Creeks. These streams are also from the Kaweah River and in flood time flow into the Tule River above Turnbull Gaging Station. This quantity should be subtracted from the total runoff from Turnbull Station when determining the exact quantity of Tule River water passing this point. The quantity in most years is not significant but believe it should be mentioned in the description of the table. In addition, there seem to be discrepancies in Table 13 flows at Turnbull Station for years of low flow.

4. The paragraph "Existing Ditch Companies", (Chapter IV, Page 34) includes a statement that upper users could possibly purchase shares from downstream users for use above Success Dam. We would like to point out that the entire present supply which is available to downstream water right holders was taken into consideration at the time supplemental water was brought into the Porterville and Lower Tule River Irrigation districts. Any depletion of the natural supply will cause a water shortage in these districts. It is our opinion that there is not any water now being used below Success Dam site, either for direct diversion or groundwater replenishment, which can be diverted upstream without adversely affecting the downstream rights. We suggest deletion of the entire paragraph inasmuch as there are no shares presently available for purchase and subsequent transfer.

5. We suggest deletion of the material headed "Friant-Kern Canal" on pages 34, 35 and 36 and the substitution of the following:

The interim supply of surplus water from the Friant Kern Canal from the Central Valley Project discussed on pages 34 and 35 would be of little

value to upstream users due to the excessive cost in construction of the necessary distribution works to serve the new land to come under production with only a partial supply. It would be many years that this water would only be available two or three months out of the year, probably only one in ten years would there be sufficient to satisfy crop needs during the entire irrigation season. This plan might be of some value when the Eastside Project could be assured and a firm contract entered into at the start of construction of the Eastside Division of the Central Valley Project.

6. The suggested purchase of some of the new irrigation yield from Success Reservoir on Page 36, in our opinion, is not a practical source of supply. This new yield is an average of 6,600 acre-feet annually, which occurs only intermittently. The comment in the same paragraph that there was a twenty year period, 1916 through 1935, where there would have been no new water available is significant.

7. The possibility of the upper Tule River Basin water users exchanging water with Tulare Lake Basin seems rather remote. This is discussed on Page 37, whereby the San Joaquin-Southern California aqueduct water would be available in 1968. The quantity of water the Tulare Lake Basin Water Storage District would have available for exchange depends upon the runoff of the Tule River and Table 13 of this report (Page 32) indicates that in many years in this short period of record no water would be available to the Lake area. Therefore, an exchange that would give the upper users dependable water would not be a possibility.

8. We suggest deletion of the first and last paragraph under the heading "Land Management" (pages 50, 51 & 52) and the substitution of the following as the first paragraph:

Local ranchers, in cooperation with the Tulare Co. Range Improvement Association, have been replacing brush with grass through the medium of controlled

burning. Whereas the improvement of range-land is the primary consideration of this conservation practice, the possible increased stream run-off is an important by-product.

9. At the present time there are 104 water conservation and stock dams in existence in the upper basin. These structures all 50 acre feet or less have, in the main, been constructed under the supervision of the U. S. Soil Conservation Service as a portion of the Federal Agricultural Conservation Program. This is a continuing program under the Authority of the Tulare County Agricultural Stabilization Committee.

10. We suggest the addition of the following paragraph under the heading "East Side Division of the Central Valley Project":

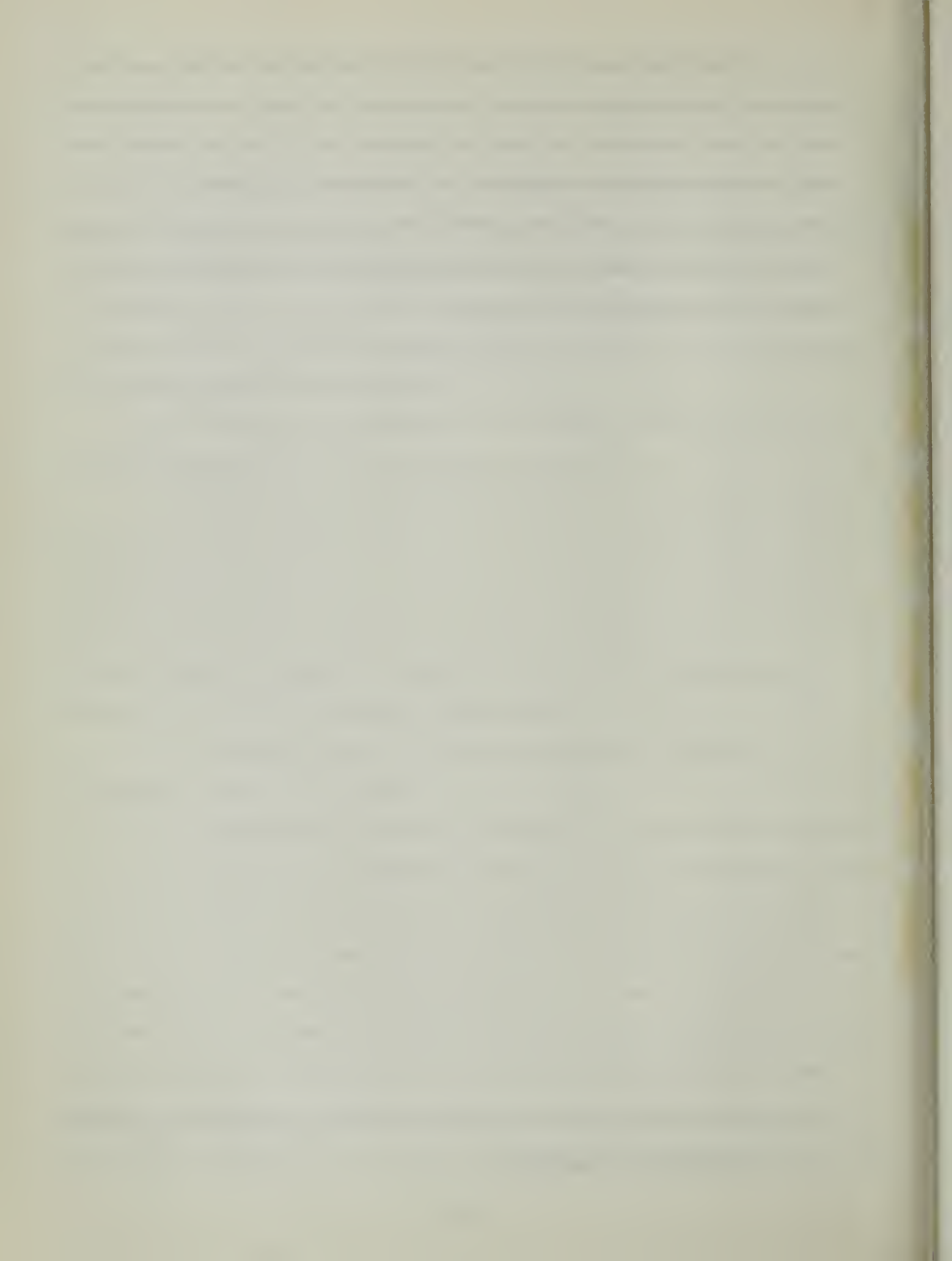
The most logical method of the upstream area obtaining a firm water supply would be the exchange method pointed out in this Bulletin with the proposed Eastside Division to the Central Valley Project, the only question here being the ultimate cost of water per acre foot to the land, which would have to include upstream development or pumping from Success Dam, plus the cost of exchange water at the Friant Kern or other canals.

11. We suggest that the following be added under the heading "Conclusions" (pages 57, 58, & 59):

It appears that the upstream development for irrigation purposes could only become feasible with a substantial cost of the initial construction of these upstream reservoirs being taken care of by recreational and urban interests, which could be either Federal, State, Local, or a combination of all. The benefits which would accrue to local business in the area above Success Dam would put them in a position where they could well afford to pay a part of the recreational potential of the area, which would include these necessary dams and reservoirs for boating, swimming, fishing and other recreational purposes, as well as an improvement of the fishing in the river downstream below the reservoirs.

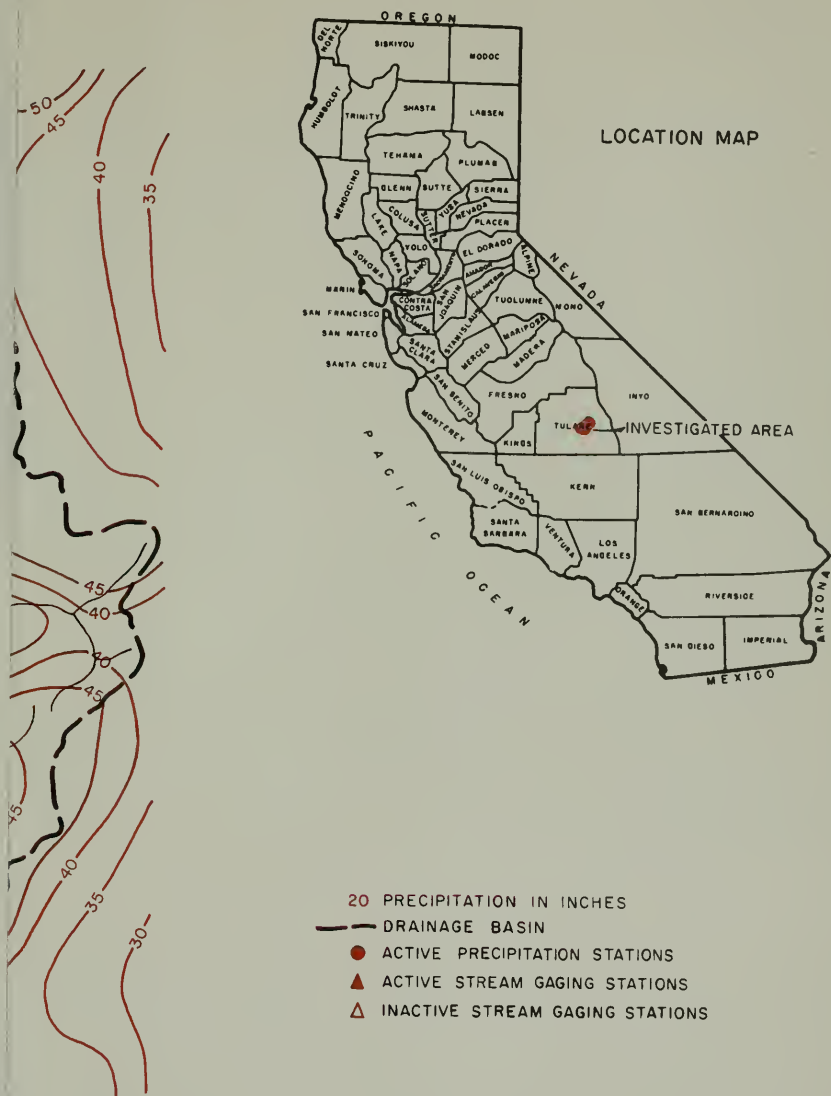
There is a possibility that the spillway at Success Dam could be gated and added storage provided at a minimum cost. Under an exchange agreement for water purchased, the Corps of Engineers would allow sufficient carry-over to assure an adequate supply in the Springville-Pleasant Valley area if a pumping plant and distribution works from Success Reservoir would be feasible. This merits further study including the possibility of organization of some type of a water district in this area.

* Table 13 has been corrected to show the value of 54,400 acre-feet, as noted by the Tulare Water Commission.

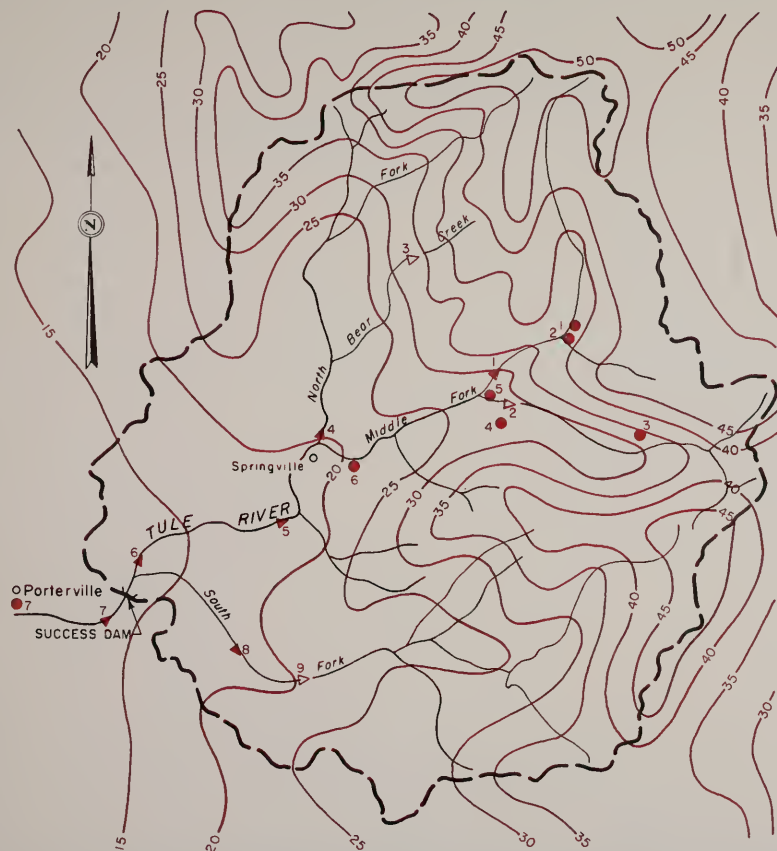


PLATES









NOTES

See Table 1 for names of precipitation stations
and Table 2 for names of gaging stations

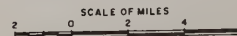
ISOWYETS FROM CORPS OF ENGINEERS, "DEFINITE PROJECT
REPORT, SUCCESS PROJECT" SACRAMENTO, 1944, BASED ON
PERIOD 1899 TO 1948

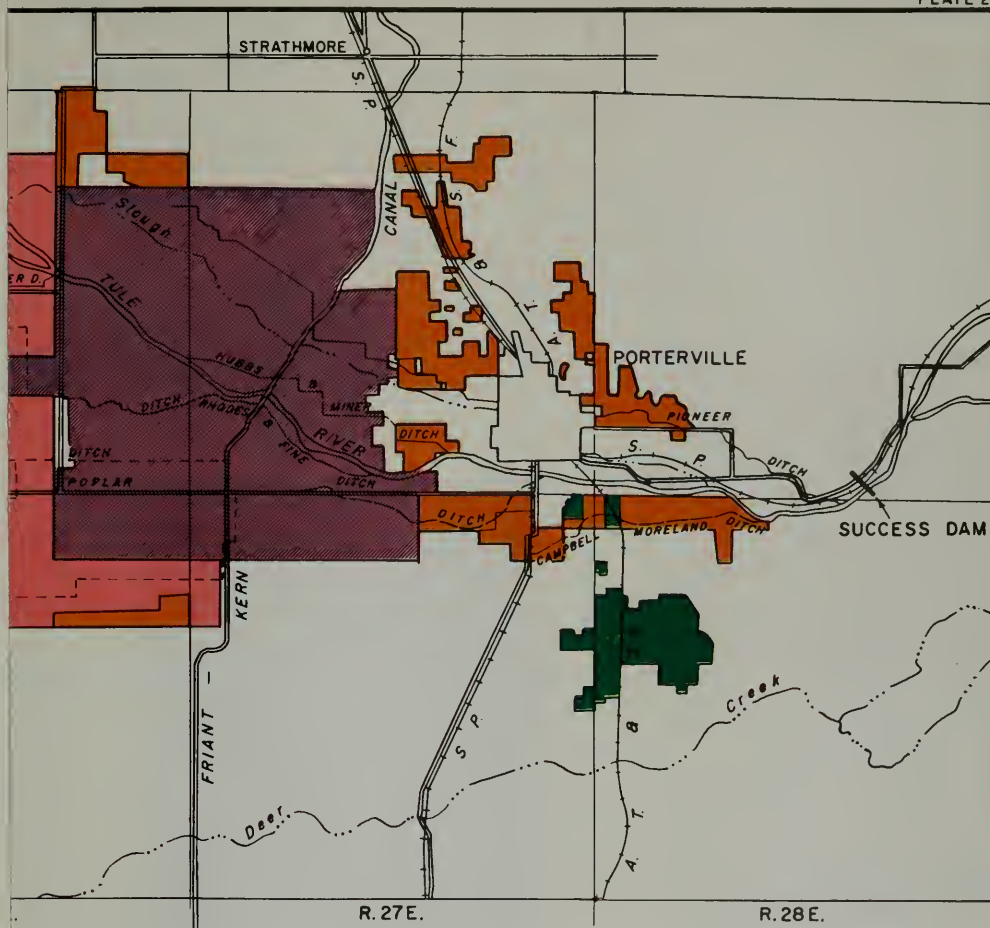


- 20 PRECIPITATION IN INCHES
- DRAINAGE BASIN
- ACTIVE PRECIPITATION STATIONS
- ▲ ACTIVE STREAM GAGING STATIONS
- △ INACTIVE STREAM GAGING STATIONS

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
DIVISION OF RESOURCES PLANNING
UPPER TULE RIVER RECONNAISSANCE
INVESTIGATION, TULARE COUNTY

— LINES OF EQUAL MEAN
SEASONAL PRECIPITATION

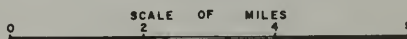


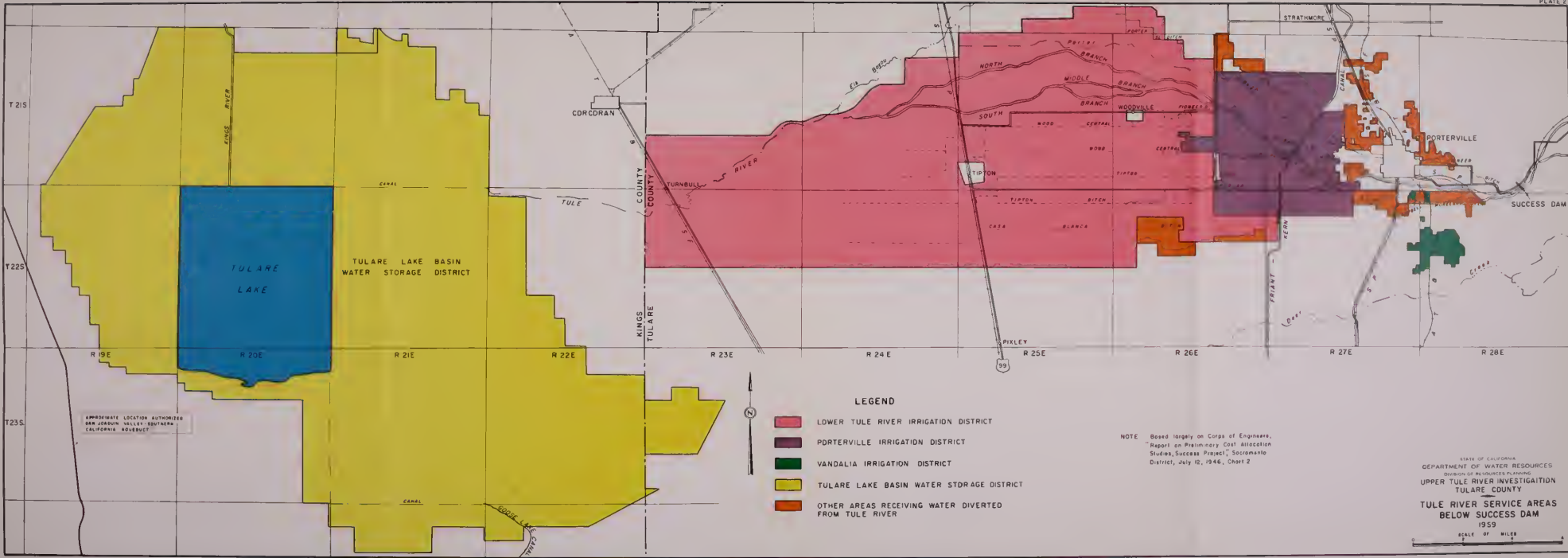


on Corps of Engineers,
 minary Cost Allocation
 s Project," Sacramento
 2, 1946, Chart 2.

STATE OF CALIFORNIA
 DEPARTMENT OF WATER RESOURCES
 DIVISION OF RESOURCES PLANNING
 UPPER TULE RIVER INVESTIGATION
 TULARE COUNTY

TULE RIVER SERVICE AREAS
 BELOW SUCCESS DAM
 1959





LEGEND

- LOWER TULE RIVER IRRIGATION DISTRICT
- PORTERVILLE IRRIGATION DISTRICT
- VANDALIA IRRIGATION DISTRICT
- TULARE LAKE BASIN WATER STORAGE DISTRICT
- OTHER AREAS RECEIVING WATER DIVERTED FROM TULE RIVER

NOTE Based largely on Corps of Engineers, "Report on Preliminary Cost Allocation Studies, Success Project," Sacramento District, July 12, 1946, Chart 2

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
DIVISION OF RESOURCES PLANNING
UPPER TULE RIVER INVESTIGATION
TULARE COUNTY
TULE RIVER SERVICE AREAS
BELOW SUCCESS DAM
1959
SCALE OF MILES
0 2 4



LEGEND



EXISTING RESERVOIR



RESERVOIR SITES



STREAMFLOW ENHANCEMENT



SERVICE AREAS



UPPER TULE RIVER BASIN BOUNDARY



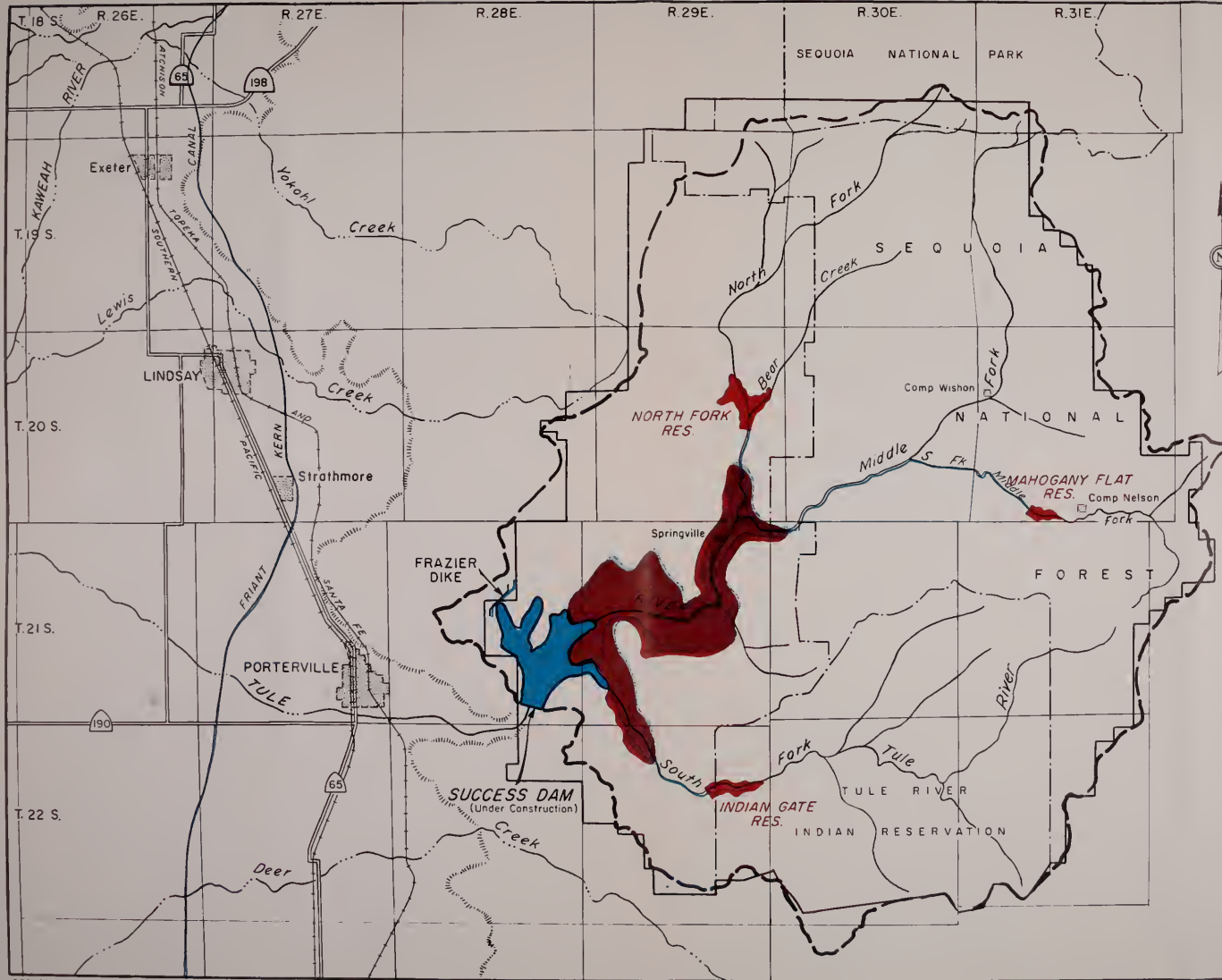
TULE RIVER SOIL CONSERVATION DISTRICT
BOUNDARY

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
DIVISION OF RESOURCES PLANNING
UPPER TULE RIVER RECONNAISSANCE
INVESTIGATION, TULARE COUNTY

POSSIBLE DEVELOPMENT

SCALE OF MILES

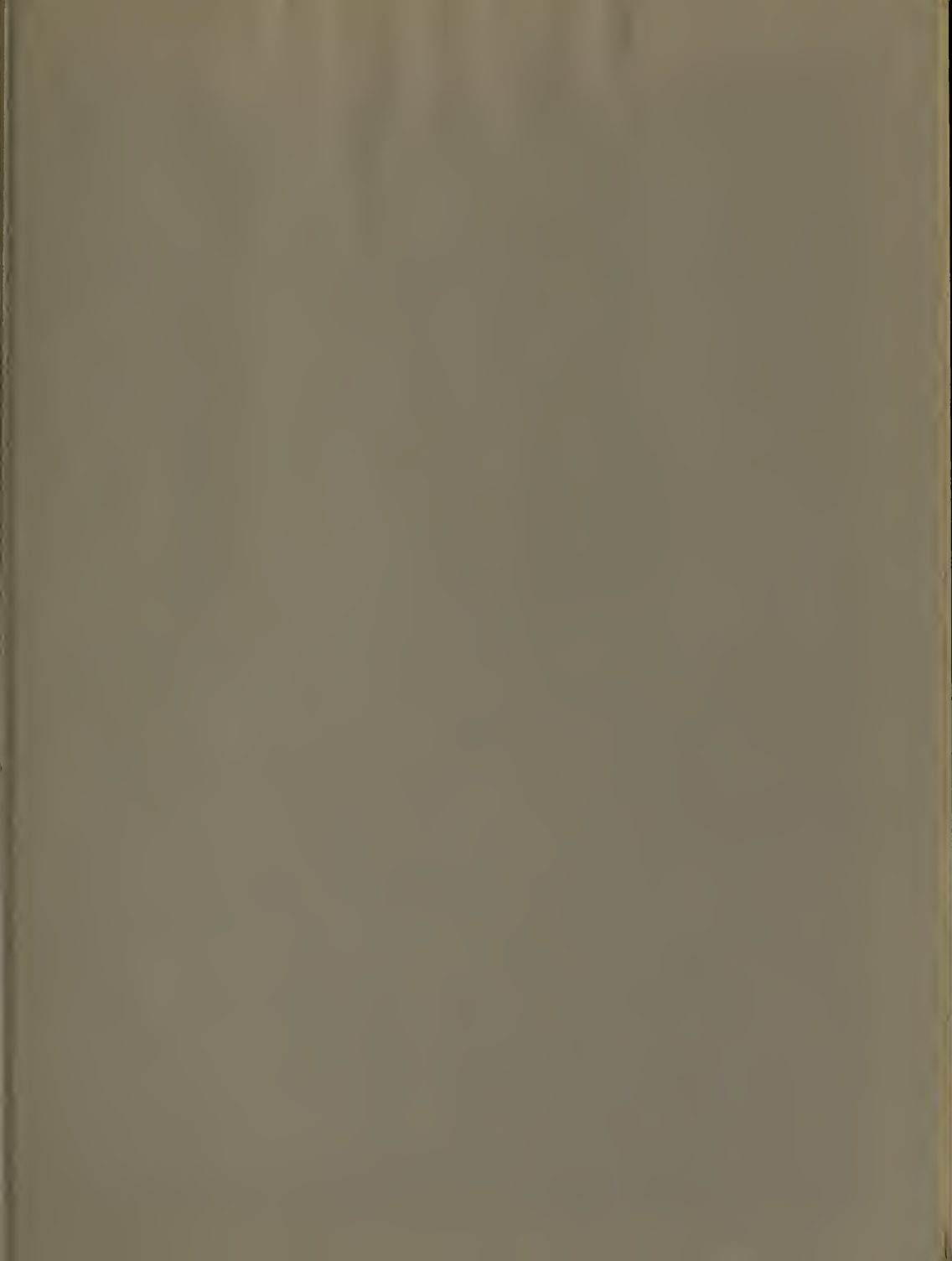




STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
DIVISION OF RESOURCES PLANNING
UPPER TULE RIVER RECONNAISSANCE
INVESTIGATION, TULARE COUNTY

POSSIBLE DEVELOPMENT
SCALE OF MILES
0 2 4 6





**THIS BOOK IS DUE ON THE LAST DATE
STAMPED BELOW**

**RENEWED BOOKS ARE SUBJECT TO IMMEDIATE
RECALL**

LIBRARY, UNIVERSITY OF CALIFORNIA, DAVIS

Book Slip-20m-8,'61 (C1623s4) 458

240510

California. Dept. of
water resources.

D. J. L. L. L. L.

240510

PHYSICAL
SCIENCES
LIBRARY

Call Number:

TC824

C2

A2

no 82

TC824

C2

A2

no 82

C2

UNIVERSITY OF CALIFORNIA, DAVIS



3 1175 02037 7225

LIBRARY
UNIVERSITY OF CALIFORNIA
DAVIS

240510

